702 OSCILLOSCOPE

Instruction Manual

Serial No. _____

FAIRCHILD

DU MONT LABORATORIES

DIVISIONS OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

MP MASTER

MA29981

TYPE

702 OSCILLOSCOPE

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DIVISIONS OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

SCIENTIFIC INSTRUMENT DEPARTMENT

750 Bloomfield Avenue, Clifton, New Jersey, U.S.A.

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Manual No. 6704 4481

TABLE OF CONTENTS

Section	Title	Page
1. TECHNICAL SUMMARY		
1-1	Introduction	1-1
1-2	Features	1-1
1-3	Technical Summary (Specifications)	1-1
1-4	List of Recommended Accessories	1-4
2. OPERATING INSTRUCTIONS		
2-1	First Time Operation	2-1
2-2	Adjustment of Y Bal Control	2-1
2-3	Thermal Cutout	2-1
2-4	Precaution Against Screen Burning	2-1
2-5	Illuminated Scale	2-1
2-6	AC or DC Coupling	2-8
2-7	Differential Input Features	2-8
2-8	Obtaining a Display	2-8
2-9	Dual-Trace Operation	2-9
2-10	Dual-Trace Triggering	2-9
2-11	Additional Hints	2-10
2-12	Use of Probes	2-10
2-13	Sweep Triggering	2-11
2-14	Trigger Source Selection	2-11
2-15	Trigger Coupling Selection	2-11
2-16	Trigger Slope Selection	2-12
2-17	Trigger Level Selection	2-12
2-18	Sweep Operational Modes	2-12
2-19	Sweep Expansion	2-13
2-20	Intensity (Z Axis) Modulation	2-13
2-21	X-Y Displays	2-13
2-22	Voltage Measurements	2-14
2-23	Time Measurements	2-15
2-24	Rise-Time Measurements	2-16
2-25	Phase Shift Measurements	2-16
3. CIRCUIT DESCRIPTION		
3-1	Introduction	3-1
3-2	Input Amplifier Circuit Description	3-2
3-3	Electronic Switch and Y Amplifier Circuit Description	3-2
3-4	Horizontal Deflection System	3-4
3-5	Trigger Circuit Description	3-4
3-6	Sweep Circuit	3-6
3-7	Low Voltage Power Supply	3-8
3-8	CRT Circuit	3-9
4. PERFORMANCE ASSURANCE TEST		
4-1	Maintenance Check to Assure Performance	4-1
4-2	Initial Setup of Type 702	4-1
4 3	Checking the Power Supply	4-1
4-4	Checking Channels A & B Volts/Cm Switches	4-1
4-5	Checking Sweep Calibration	4-1
4-6	Checking Bandwidth of Channels A & B	4-3
4-7	Checking Rise Time of Channels A & B	4-3
4-8	Checking Bandwidth of X Amplifier	4-3
4-9	Checking Mode Switch	4-4
5. MAINTENANCE AND RECALIBRATION		
5-1	Introduction	5-1
5-2	Removal and Replacement of Parts	5-1
5-3	Cathode-Ray Tube Replacement	5-2
5-4	Servicing Hints	5-2
5-5	Test Equipment Required for Service Adjustments	5-3
5-6	Adjusting the Low and High Voltage Power Supplies	5-3
5-7	CRT Adjustments	5-4
5-8	X R2029 and Y R1325 Output Level Adjustments	5-4
5-9	Channels A & B DC Balance Adjustments	5-4
5-10	Channels A & B Position Balance Adjustments	5-4
5-11	Normalizing Y Amplifier Sensitivity and Certifying the Calibrator	5-5
5-12	Channels A & B Input Capacitance Adjustment	5-5
5-13	Channels A & B Attenuator Alignment	5-6
5-14	Adjust Output Peaking Compensation C1304	5-6
5-15	X Attenuator Alignment	5-6
5-16	X Balance Adjustment	5-6
5-17	Normalizing X Amplifier	5-6
5-18	Sweep Length Adjustment	5-7
5-19	Fast Sweep Calibration Adjustment	5-7
5-20	Phase Shift Adjustment C2013	5-7
6. PARTS LISTS AND SCHEMATICS		
6A	Electrical Parts List	6-1
6B	Spare Parts List	6-5
	List of Recommended Vendors	6-7
CHARTS		
	Amplitude Check Calibration Chart	4-1
	Sweep Check Calibration Chart	4-2
ILLUSTRATIONS		
Figure	*Title*	*Page*
1-1	Type 702 Oscilloscope	1-0
2-1	Type 702 Front Panel Facilities, CRT System	2-2

ILLUSTRATIONS (Continued)

Figure	*Title*	*Page*
2-2a	Type 702 Front Panel Facilities, Dual Vertical Deflection System	2-3
2-2b	Type 702 Front Panel Facilities, Dual Vertical Deflection System	2-4
2-3	Type 702 Front Panel Facilities, Trigger and Time Base System	2-5
2-4	Type 702 Front Panel Facilities, Horizontal Deflection System	2-6
2-5	Initial Setup of Type 702 Oscilloscope	2-7
2-6	Illustrating Differential Operation	2-8
2-7	Peak-to-Peak Voltage Measurements	2-14
2-8	Instantaneous Voltage Measurement with Respect to Ground (or some other reference potential)	2-15
2-9	Elapsed Time Measurement	2-15
2-10	Finding the Frequency	2-15
2-11	Rise-Time Measurement	2-16
2-12	Phase Shift Measurements	2-16
3-1	Type 702 Channels A & B Pre-Amplifiers, Functional Block Diagram	3-1
3-2	Type 702 Electronic Switch and Y Deflection Amplifier, Functional Block Diagram	3-3
3-3	X Input Circuit, Simplified Functional Block Diagram	3-4
3-4	X Deflection Amplifier, Functional Block Diagram	3-5
3-5	Trigger Circuit, Functional Block Diagram	3-6
3-6	Sweep Generator, Simplified Diagram	3-7
4-1	Initial Setup of Type 702 Oscilloscope	4-2
4-2	Test Setup for Bandwidth Measurement	4-3
5-1	Type 702 Over-All System Block Diagram	5-1
5-2a	Test Setup for Adjusting Input Capacitance	5-5
5-2b	Standardizing the Input Capacitance	5-5
5-3a	Top View Showing Attenuator Trimmers and Pot Adjustments	5-8
5-3b	Top View Showing Transistors and Tubes	5-9
5-4	Bottom View Showing Input Trimmers, Transistors and Tube Location	5-10
5-5	Rear View Showing Transistors, Tube Location and Pot Adjustments	5-11
6-1	Front Panel Replaceable Parts	6-0

NOTES

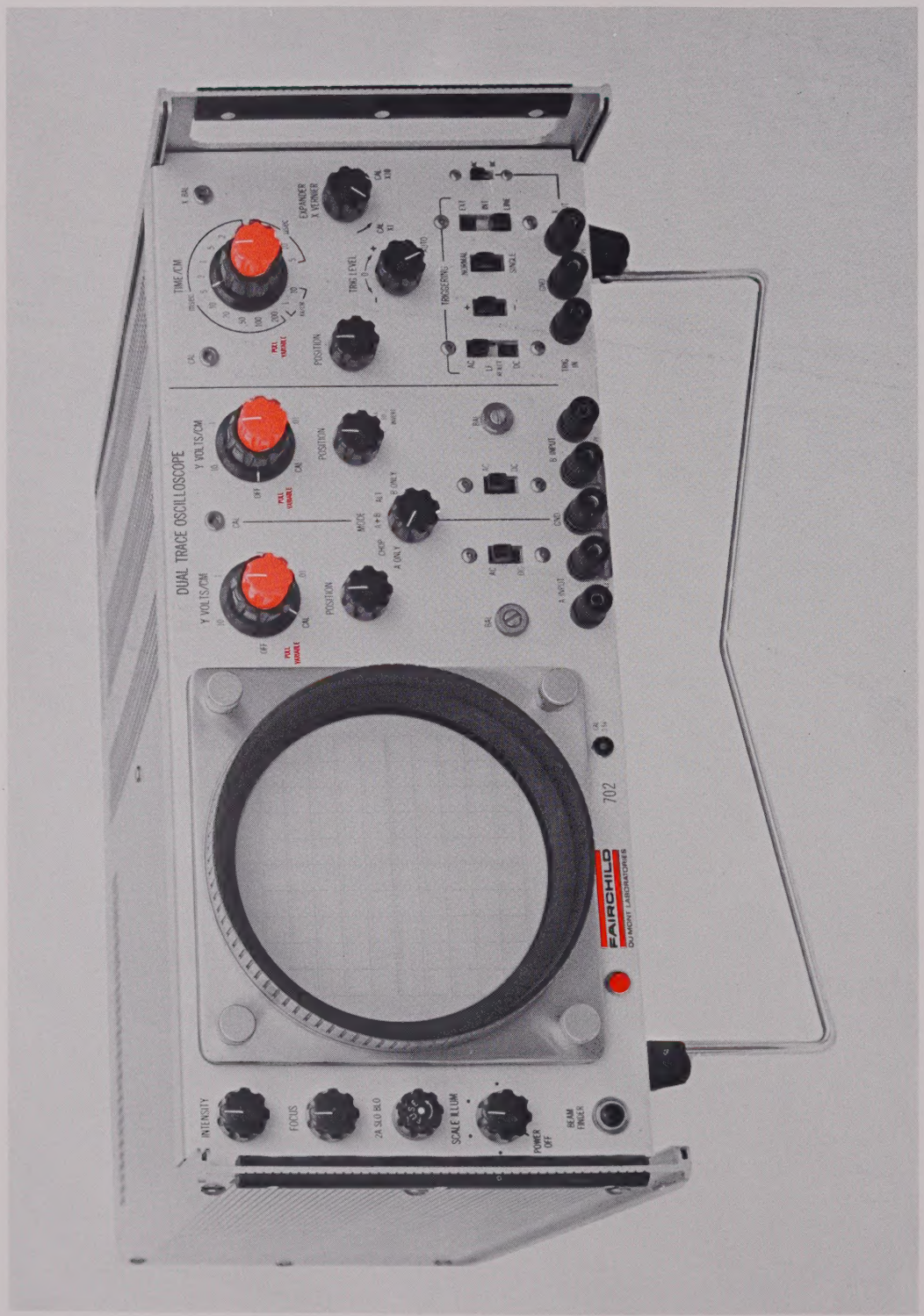


Figure 1-1. Type 702 Oscilloscope

SECTION 1
TECHNICAL SUMMARY

1-1. INTRODUCTION

The Type 702 Dual Trace Transistorized Oscilloscope is a precise measuring instrument designed to be used for almost any general application. Simplicity of operating controls assures reliable performance in laboratory, factory, and field applications. Accurate measurements can be made of electrical waveforms from dc to 500 Kc at calibrated sweep rates of 0.5 μsec/cm to 200 msec/cm.

1-2. FEATURES

- Constructed for universal bench or rack use. A tilt foot assembly for bench use is supplied with each unit
- General purpose oscilloscope that is *easy-to-use,* rugged and reliable
- Frequency response and gain of the Y amplifier extends from dc to 3 db down at 500 Kc at a sensitivity of 10 millivolts/cm
- Frequency response and gain of the X amplifier extends from dc to 3 db down at 350 Kc at a sensitivity of 100 millivolts/cm
- Calibration voltage is provided
- Calibrated linear sweep rates from 5 microseconds/cm to 200 milliseconds/cm in fifteen steps of 1, 2, and 5 sequence
- Uncalibrated linear sweep, continuously variable in rate from 5 microseconds/cm to 1 second/cm. Longest sweep time is 10 seconds full scale
- Driven, automatic, or single (armed) sweep operation with automatic forward trace brightening
- A calibrated 10 times expander extends the fastest sweep to 0.5 μsec/cm and features continuous control from X1 to X10 for viewing sweeps of various expansions
- The new high resolution cathode-ray tube is driven by transistorized amplifiers and can be supplied with an illuminated *no-parallax* graticule
- Silicon transistors and fully regulated electronic power supplies assure maximum drift stability and long-term reliability

1-3. TECHNICAL SUMMARY (Specifications)

The electrical characteristics of the Type 702 Dual Trace Oscilloscope are listed in the Performance Specification which follows.

SPECIFICATIONS

VERTICAL-DEFLECTION SYSTEM

Bandwidth

Direct Coupled: DC to 500 Kc; down 3 db at 500 Kc

Capacitively Coupled: Low-frequency cutoff is 2 cycles

Rise Time: 0.7 microsecond with less than 2% overshoot

Sensitivity

10 mv/cm to 10v/cm in 4 decade steps; accurate to within ±3%. An OFF position is included for dc balancing

The PULL VARIABLE control permits 10 to 1 continuous sensitivity adjustments between the attenuator steps and extends the 10v/cm range to 100v/cm. The VARIABLE knob is provided with a push-pull switch to facilitate calibration check; the pulled knob indicates uncalibrated vernier gain setting

Input Impedance

1 megohm, ±3% paralleled by 44 pf ±2.2 pf when driven single ended. When driven differentially, 2 megohms paralleled by less than 40 pf. Input impedance constant on all ranges of the attenuator

Input Connectors

Combination binding posts spaced on 3/4-inch centers to accommodate Type 2592-B shielded terminal adapter. Two binding post connectors are provided for differential input and a ground binding post and connector strap are provided for single-ended amplifier operation

Differential Input

Available only on the 0.01 Volts/Div setting. Input impedance is 2 megohms shunted by less than 40 pf on 10 mv/cm range. Sensitivity may be decreased to 100 mv/cm with VARIABLE control

Common Mode Rejection

A Only and B Only modes. Nominally 120:1, always better than 100:1 (40 db). Measured at 60 cycles and not controlled at higher frequencies. Common mode signal must not exceed 6 volts peak-to-peak ac or ±3 volts dc

A-B Mode

Common mode signal input should not exceed 2 screen diameters in either channel

HORIZONTAL-DEFLECTION SYSTEM

Bandwidth

Direct Coupled: DC to 350 Kc; down 3 db at 350 Kc

Capacitively Coupled: Low-frequency cutoff is 2 cycles

Sensitivity

Three calibrated steps of 0.1v/cm, 1v/cm and 10v/cm; ±5%. The EXPANDER VERNIER control permits continuous adjustments from 0.1v/cm to 100v/cm

Input Impedance

1 megohm shunted by 44 pf

TRIGGERING SYSTEM

Internal Trigger

Sweep will trigger from 1/2 centimeter of vertical signal on normal and single sweep positions from dc to 500 Kc. Less than 4 millimeters are required in the auto triggering position. A choice of trigger polarity (slope) is available

Line Trigger

Line frequency triggering can be selected in either polarity and the triggering point may be shifted with the TRIG LEVEL control

External Trigger

0.5 volt peak-to-peak from dc to approximately 500 Kc will trigger the sweep. Approximately 0.4 volt peak-to-peak is required for auto triggering operation. Trigger leveling, polarity selection and ac or dc coupling are included

AC Coupling

High-pass filter with low-frequency cutoff of 80 cycles

DC Coupling

Direct coupling is provided to optimize trigger sensitivity when very slow waveforms are applied; to maintain the initial reference position of the trace with respect to the CRT scale at a given trigger level setting; and to avoid trigger point variations due to random repetition rate trigger signals

LF Reject

Differentiated trigger input; high-pass filter is provided to reject hum and low-frequency amplitude modulation; low-frequency cutoff nominally 15 Kc. Signals should rise or fall faster than 100 μsec to pass LF Reject filter

Trigger Slope

Selection of positive or negative slopes on Internal, Line, or External triggering is available

Trigger Level

A range of ±10 volts for External trigger input or 1-1/2 times full scale on internal triggering

Automatic Triggering

Auto triggering is available on Internal, External, and Line trigger sources. Auto triggering simplifies synchronization and provides a continuous base line at a frequency of approximately 50 cycles

OPERATIONAL MODES

Electronically switched dual trace single gun CRT is provided with the following displays:

1. Channel A only
2. Channels A and B on chopped display with blanking
3. Channel A plus Channel B normal; pull to invert switch permits A minus B display
4. Channels A and B on alternate sweep
5. Channel B only

TIME BASE SYSTEM

Sweep Range

Calibrated linear sweep rates from 5 μsec/cm to 200 ms/cm in 15 steps of 1, 2, and 5 sequence

The PULL VARIABLE control provides a continuous uncalibrated range of sweep rates between ranges and extends the 200 ms/cm range to 1 sec/cm (10 seconds full scale)

Sweep Accuracy

Normally within ±2%; always within ±3% (averaged over the centered 8 cm portion of the CRT screen)

Sweep Expansion

The calibrated sweep may be expanded about center of screen 10 times. Extends fastest sweep rate to 0.5 us/cm within 10%. Continuous expansion from X1 to X10 is provided

Expanded Sweep Positioning

Sufficient to position any full scale portion of the expanded trace on the screen

Single Sweep

An unblanked single-sweep mode is available with manual reset via a front-panel switch

CATHODE-RAY TUBE DATA

Type

F7010-0-P31, tight tolerance, high resolution cathode-ray tube is normally supplied; 2500 volts accelerating potential

Optional Phosphors

P7 phosphor for long persistence low frequency or transient observation; P11 for photographic use; and P2 phosphor for combination visual and photographic use are also available

Bezel

Light-tight bezel provides firm mount for an oscilloscope camera and permits ready interchange of filters and scales.

Graticule

Engraved edge-lit graticule having 10 cm by 10 cm graduations and appropriate color filter over face of tube. Scale illumination level from zero to intensity adequate for photographic recording. CRT internal no-parallax graticule is optionally available

Beam Finder

A spring-loaded push-button switch is provided to facilitate location of beam when it is positioned off screen

Z Axis (Type 7088 Option)

Negative pulse to grid of CRT blanks trace. 25 volts are required into an impedance of approximately 600K ohms coupled via 3300 pf capacitor to dim trace

VOLTAGE CALIBRATOR

Availability

0.5V peak-to-peak calibrator signal available at pin jack on front panel; fast rise and fall time permits adjustment of attenuator probes. Calibrator signal of 50 mv is applied to the input of Y amplifier to standardize gain when VOLTS/DIV switch is set to CAL

Accuracy

Nominally ±1%, always within ±3%

Frequency

Locked to power-line frequency. This signal may be used to calibrate the time axis wherever the power-line frequency is a controlled standard

section 1—technical summary

POWER REQUIREMENTS

Line Voltage

From 105 to 125 volts or from 210 to 250 volts at 60-cycle line

Line Frequency

Operation from 48 through 450 cycles; line voltage excursion is reduced at extremes of frequency range and where power line distortion exceeds 5%

Power

170 watts average; 210-volt amperes at 115-volt, 60-cycle line

DC Power Supplies

All supplies including the critical tube heaters are electronically regulated

MECHANICAL DIMENSIONS

Note: This oscilloscope is constructed for universal bench or rack use

	BENCH		*RACK		
Height	7-5/8"	(19.4 cm)	6-31/32"	(17.7 cm)	
Width	16-3/4"	(42.5 cm)	19"	(48.3 cm)	
Depth	19-1/2"	(49.5 cm)	17-1/2" 16-1/2"	(44.5 cm) (42 cm)	Normal Mounting Bracket Reversed
Weight	29 lbs	(13.2 kg)	29 lbs	(13.2 kg	
Shipping Weight	40 lbs	(18.2 kg)	40 lbs	(18.2 kg)	

* A minimum of 2" clearance must be maintained for the rack-mounted model to assure adequate cooling. Do not subject the unit to the hot exhaust air of adjacent equipment.

1-4. LIST OF RECOMMENDED ACCESSORIES

Type or Part Number	Description
	COLOR FILTERS
4800 5861	amber for P7 screen
4800 5862	blue for P11 or P7 screen
4800 5863	green for P2 or P31 screen
4800 6101	neutral filter, circularly polarized
	RECORDING CAMERAS
450A/453A	Oscilloscope record camera with suitable accessories

TYPE 4002B GENERAL ACCESSORY KIT

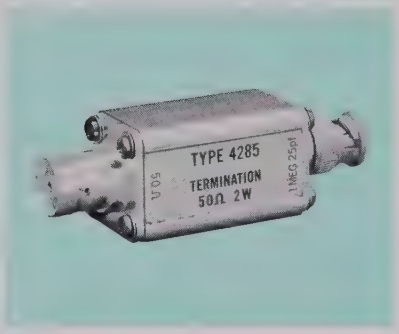
This kit includes the components listed as follows:

Qty	Part Number	Description
2	0903 6940	Type 7080 Adapter Connector; BNC-type-to-binding post adapter; UG-1090/U
1	8700 1224	Type 4002A Electrical Test Fixture (620K-ohm resistor)
2	9800 0629	Type 2592-B Shielded Terminal Adapter; this is a binding-post-to-BNC-type adapter
1	9800 1941	Type 276-C Viewing Hood
1	9800 2172	Type 4290 10:1 Attenuator Probe terminated in BNC type connector; 10M ohms, 10 pf input
1	0905 8940	Type 7084 Adapter Connector; UG-636/U C male to BNC female
1	9800 2112	Type 4285 50-ohm, 2-watt termination
1	5028 8581	Type 7083 BNC to Alligator Clip Jumper Cable

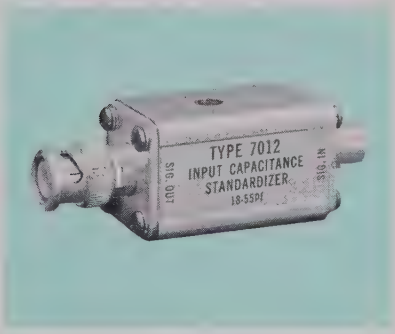
TYPE 276-C
Viewing Hood

TYPE 2592B
Shielded adapter connector; scope binding post to BNC

TYPE 4002B
General Accessory Kit



TYPE 4285A
50-ohm, 5-watt Termination



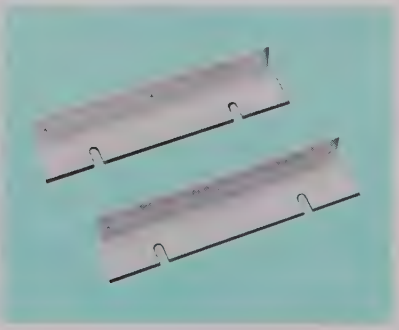
TYPE 7012
Capacitance Standardizer

TYPE 7013
Recalibration Tool Kit

TYPE 7030
Scope Traveler

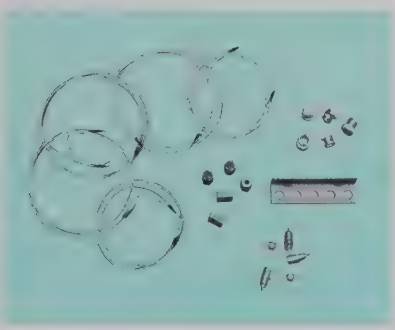
TYPE 7083
BNC to alligator clip; jumper cable (42")

TYPE 7085
Rack Mounting Slides



TYPE 7086
Pair of rack-mounting ears

TYPE 7088
Z-axis Modulation Kit



TYPE 7089
Rear Access Connector Kit

NOTES

SECTION 2
OPERATING INSTRUCTIONS

2-1. FIRST TIME OPERATION (Figures 2-1 to 2-5)

To place the instrument in operation, plug the power cord into the proper grounded power source and turn INTENSITY control counterclockwise. Rotate the SCALE ILLUM control clockwise to apply power. Allow approximately 15 minutes for the instrument to warm up. In the instructions which follow, the words in capital letters within the text indicate front-panel controls, connectors, or settings.

Numerous accessory components are available to extend the usefulness of these oscilloscopes. See Section 1 for a complete listing.

The following illustrations are designed to aid the operator in becoming familiar with the oscilloscope.

Figure 2-1.	Type 702 Front-Panel Facilities, CRT System
Figures 2-2a & 2-2b	Type 702 Front-Panel Facilities, Dual Vertical Deflection System
Figure 2-3.	Type 702 Front-Panel Facilities, Trigger and Time Base System
Figure 2-4.	Type 702 Front-Panel Facilities, Horizontal Deflection System
Figure 2-5.	Initial Setup of Type 702 Oscilloscope

We know that you are anxious to get acquainted with your new instrument. To aid you in this endeavor, you may set up the instrument using the built-in calibrator signal to demonstrate the effects of the various controls on the display. See Figure 2-5.

2-2. ADJUSTMENT OF Y BAL CONTROL

If the Y BAL control of the Type 702 Oscilloscope is not properly adjusted, the reference trace on the screen will be depositioned when the PULL VARIABLE control is rotated. To properly adjust the Y BAL front-panel screwdriver control for Channel A, proceed as follows:

1. Set Y VOLTS/CM switch to OFF and pull out the Y PULL VARIABLE control and rotate it fully counterclockwise.
2. Turn TRIG LEVEL control clockwise to AUTO (detented position).
3. Using Channel A POSITION control, position the trace to screen center (reference line).

Note: It may be necessary to depress and hold the BEAM FINDER button and adjust the Y BAL control to position the trace on the screen.

4. Turn Y PULL VARIABLE control clockwise, and note any deflection.
5. Adjust the Y BAL control until the trace is positioned to the reference line established in step 3. Do *not* change the POSITION control setting.
6. Continue to adjust the Y BAL control until there is no depositioning of the trace when the Y PULL VARIABLE control is rotated back and forth throughout its range.
7. Repeat above setup (steps 1 through 6) for Channel B.

2-3. THERMAL CUTOUT

A thermal cutout switch is connected in series with one side of the power line of this instrument. When the interior temperature of the instrument exceeds the safety limit, the thermal cutout switch will trip, removing power from the unit. It will reset itself when the interior temperature drops to a safe value. Possible causes of over-heating are restriction of air circulation or high ambient temperature. Rack installation should be designed with a nominal clearance of 2 inches all around (1-1/2 inches minimum) and hot air must not be circulated through the oscilloscope.

2-4. PRECAUTION AGAINST SCREEN BURNING

A sharply focused spot of high intensity and small area should not be permitted to remain stationary on the screen for any length of time. Under such conditions, the entire beam energy is concentrated over a small area, thus subjecting the screen material to burning and discoloration. This condition is most likely to exist when using the unit for x-y plotting with the INTENSITY control turned up, and with no signal to deflect the beam.

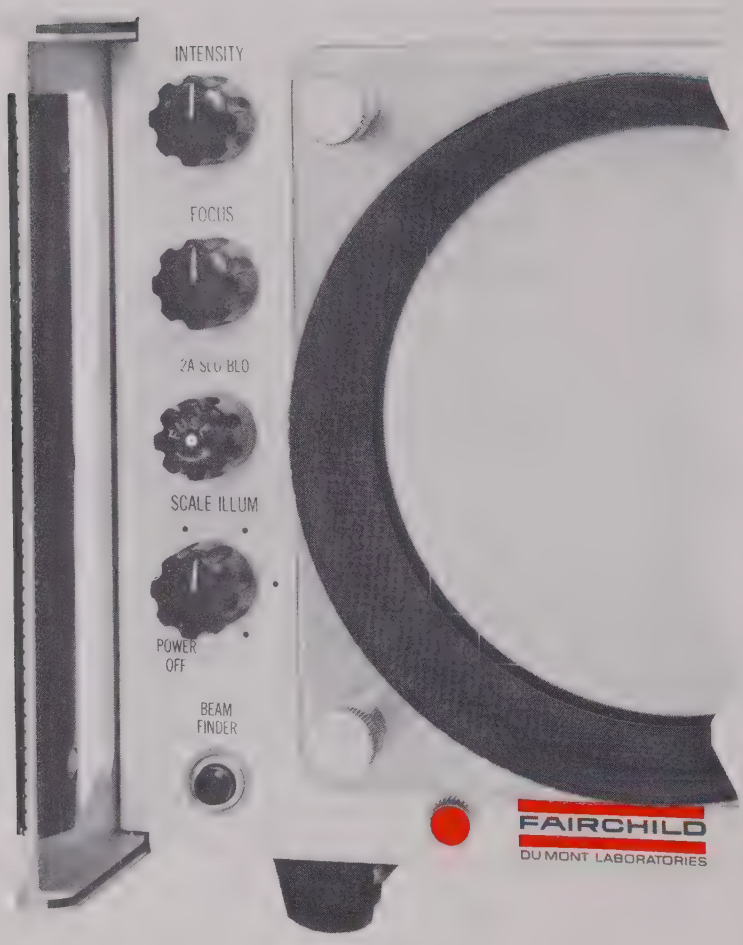
2-5. ILLUMINATED SCALE

The adjustable scale lighting control labeled SCALE ILLUM may be adjusted to suit the lighting conditions of the room or the f/number on the oscilloscope camera.

The scale is accurately scribed in centimeters. These scale markings and the calibrated fixed attenuator markings and sweep rates can be used to convert deflection in centimeters into volts and seconds. Vertical sensitivities are calibrated in volts/cm and sweep rates are calibrated in seconds per centimeter which when multiplied by the number of centimeters of deflection give the voltages and seconds. An illuminated internal no-parallax graticule is optionally available. No special techniques or equipment are required to photo-record from the Fairchild Internal No-parallax Graticule.

INTENSITY

Control: varies trace brightness



FOCUS

Control: adjusts trace sharpness

SCALE ILLUM

Control with switch: dimmer control varies scale illumination; attached switch turns power on or off

PILOT LAMP

Illuminated lamp indicates application of primary power

BEAM FINDER

Spring-loaded switch: reduces amplifier output and scales down the display, thus permitting location of the trace and centering it with the X & Y POSITION controls

Figure 2-1. Type 702 Front Panel Facilities, CRT System

Y VOLTS/CM

Outer knob (black): one of two identical attenuators; provides a discrete, calibrated attenuator for Y input, signals with sensitivity as indicated on the front panel (PULL VARIABLE in). CAL & OFF settings also provided

PULL VARIABLE

Inner knob (red): one of two identical controls; provides a 10 to 1 variable adjustment permitting minimum sensitivity and overlap of the Y VOLTS/CM setting; push-pull switch serves as an indicator of calibrated or vernier operation

POSITION

One of two identical controls: used to position the trace vertically. Channel B control is provided with a push-pull switch to permit polarity inversion

BAL

One of two identical screwdriver controls: when properly adjusted prevents depositioning of the pattern when VARIABLE control is used

AC/DC

One of two identical two-position slide switches: provides choice of AC or DC coupling of Y input signals

Figure 2-2a. Type 702 Front Panel Facilities, Dual Vertical Deflection System

CAL

Screwdriver control: sets gain of Y amplifier for specific deflection to insure accuracy of vertical amplitude measurements

MODE

Switch: used to select the channel in the following manner:

1. Channel A only
2. Ch A & Ch B time-shared (Chopped)
3. Algebraic summation of Channels A & B
4. Ch A & Ch B switched alternately
5. Channel B only

A INPUT or B INPUT

Binding posts: for applying external signals to the vertical deflection amplifier. Remove ground link for differential input

CAL 0.5V

Enables calibration check of 10:1 probe when VOLTS/CM switch is set to 10 millivolts

Figure 2-2b. Type 702 Front Panel Facilities, Dual Vertical Deflection System

TIME/CM

Outer knob (black): selects discrete, calibrated sweep rates as indicated on front panel (PULL VARIABLE in). X V/CM sector provides for application of X INPUT signals with attenuations of 1:1 or 10:1

PULL VARIABLE

Inner knob (red): provides a continuous, uncalibrated range of sweep rates within the limits established by the TIME/CM setting; push-pull switch assures calibrated sweep rates

TRIG LEVEL

Control with switch: selects trigger signal voltage at which the sweep is fired; switch actuation permits AUTOmatic triggering

TRIGGERING

Two, 3-position and two, 2-position slide switches: enables trigger selection from internal or external source, direct or capacitive coupling, choice of slope polarities, and normal or single sweep operation as indicated on front panel

TRIG IN

Binding post: for applying external triggering signal through EXT position of Trigger Source slide switch

Figure 2-3. Type 702 Front Panel Facilities, Trigger and Time Base System

EXPANDER/X VERNIER

Control with two detented switch settings: this control provides a 10:1 continuous expansion of the internal sweep or of the X INPUT signal

The attached switch provides calibrated sweep expansion of 1 or 10 and fixed gain of 1 or 10 of the X INPUT signal (detented settings)

X BAL

Screwdriver control: when properly adjusted, provides for equal expansion about screen center of internal sweep or external X signals

CAL

Screwdriver control: sets gain of X amplifier for specific deflection to insure accuracy of horizontal amplitude and time

POSITION

Control: positions trace horizontally

AC/DC

Two-position slide switch: provides choice of ac or dc coupling of X INPUT signals

X INPUT

Binding posts: for applying external signals to the horizontal deflection amplifier via the X V/CM sector of the TIME/CM switch

Figure 2-4. Type 702 Front Panel Facilities, Horizontal Deflection System

To obtain the calibrator display, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced when obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.

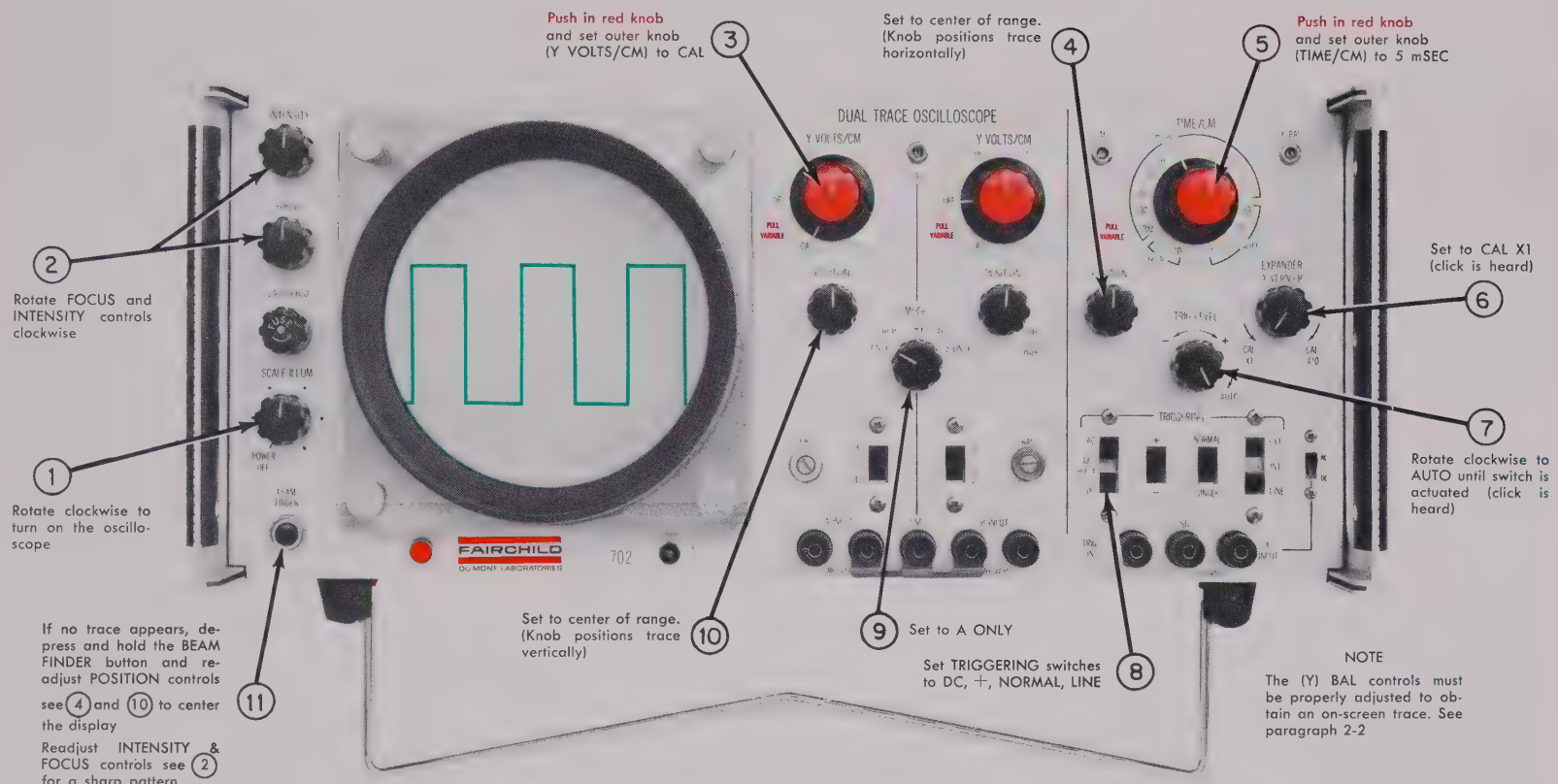

Push in red knob and set outer knob (Y VOLTS/CM) to CAL
3
Set to center of range. (Knob positions trace horizontally)
4
5
Push in red knob and set outer knob (TIME/CM) to 5 mSEC
DUAL TRACE OSCILLOSCOPE
Y VOLTS/CM
Y VOLTS/CM
TIME/CM
2
Rotate FOCUS and INTENSITY controls clockwise
Set to CAL X1 (click is heard)
6
1
Rotate clockwise to turn on the oscilloscope
7
Rotate clockwise to AUTO until switch is actuated (click is heard)
FAIRCHILD
702
If no trace appears, depress and hold the BEAM FINDER button and readjust POSITION controls see 4 and 10 to center the display
Readjust INTENSITY & FOCUS controls see 2 for a sharp pattern
11
Set to center of range. (Knob positions trace vertically)
10
9
Set to A ONLY
Set TRIGGERING switches to DC, +, NORMAL, LINE
8
NOTE
The (Y) BAL controls must be properly adjusted to obtain an on-screen trace. See paragraph 2-2

Figure 2-5. Initial Setup of Type 702 Oscilloscope

2-6. AC OR DC COUPLING

Each channel is provided with an AC/DC two-position slide switch. This switch permits choice of retaining the dc level of the input signal or blocking the dc component of the input signal by inserting a capacitor in series with the input. If it is desired to display both the ac and dc components of a signal, set the slide switch to DC. Thus, the position of the display at any instant is a function of the instantaneous signal voltage with respect to ground.

There are times when it is neither necessary nor desirable to display the dc component of the input waveform. A capacitor placed in series with the input connector will exclude the dc component while simultaneously permitting the ac component to be displayed. This is accomplished when the slide switch is set to AC. The effect of the dc component is now excluded from the display.

2-7. DIFFERENTIAL INPUT FEATURES (Figure 2-6)

For Y differential input, remove the link from the normally grounded Y INPUT binding post and apply the signals between it and the normal input terminals. The differential input feature is available only on the 0.01 position of the Y VOLTS/CM switch.

One of the salient features of the three-terminal balanced-to-ground input circuit is the behavior of the differential amplifier. This circuit makes it possible to reject to a considerable degree any common-mode signal, while at the same time passing and amplifying the differential input signal. Thus, if there is any balanced-to-ground pickup of noise on test leads or in the equipment under test, such noise will be reduced materially on passing through the differential amplifier circuit.

2-8. OBTAINING A DISPLAY

To use the Type 702 Oscilloscope to obtain a display, proceed as follows:

1. The signals to be displayed are applied to the A INPUT and/or B INPUT binding posts on the front panel. To insure proper performance, the signal should be applied through a shielded cable, with the shield connected to the chassis of both the oscilloscope and the signal source.
2. Accessory Probes are available for use with this oscilloscope and are listed in Section 1 of this manual.
3. The AC/DC two-position slide switch permits choice of capacitive or direct coupling of the signal to the compensated attenuator as discussed earlier.

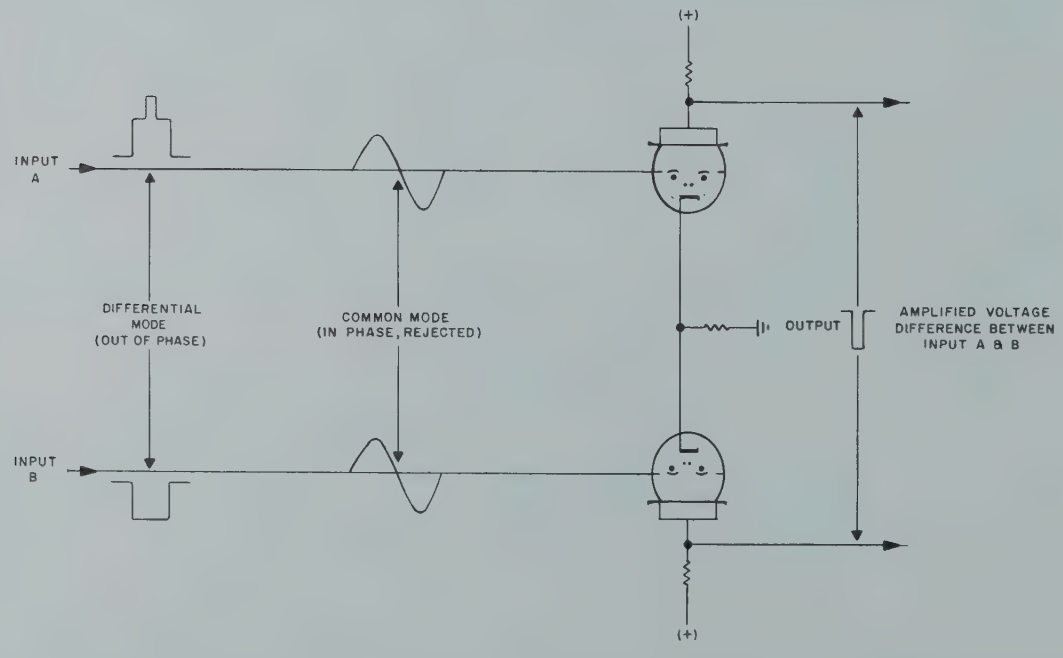


Figure 2-6. Illustrating Differential Operation

4. Use Internal Trigger Source and Auto triggering mode in setting up the display.

5. Set the Y VOLTS/CM switch and POSITION controls such that the size and position of the display is as desired on the screen. If necessary, use the BEAM FINDER push button to speedily locate the display.

6. If it is desired to display a single trace on the oscilloscope, simply apply the signal to either Input connector and set the MODE switch to the corresponding channel.

7. To display a single signal independently when the same or two different signals are applied to the channel input connectors, set the MODE switch to A ONLY to display only the Channel A input; to B ONLY to display only the Channel B input.

8. To display two signals simultaneously, connect a signal to each Input connector and set the MODE switch to ALT or CHOP. The chopped position is used when it is desired to reduce the "flickering" of the display when observing input signal data at slow sweep speeds (below 1 millisecond/cm).

External triggering of the Time Base is to be preferred in chopped position to prevent the sweep from triggering on the "chopping" signal. In general, the CHOP position is used with lower sweep rates and the ALT position with higher sweep rates.

9. To display the algebraic sum of two signals, connect a signal to each Input connector and set the MODE switch to A+B.

10. To display the algebraic difference of two signals, or Channel A minus Channel B presentation, apply the signal to each Input connector. Set the MODE switch to A+B and pull out the Channel B POSITION knob. This technique inverts the signal applied to Channel B and renders a Channel A minus Channel B presentation on the CRT screen.

11. Set the TRIG LEVEL control to AUTO.

12. Set the Y VOLTS/CM switches and POSITION controls such that the size and position of the display is as desired on the screen.

2-9. DUAL-TRACE OPERATION

Application of the Type 702 Oscilloscope makes it possible to view two different time-shared vertical input signals displayed against one time base. The electronic switch will alternately accept either the Channel A or Channel B signal when the MODE switch is set to ALT. Each channel retains individual control of sensitivity and position. Should the sweep rate be so low that the display has excessive flicker, the MODE switch may be set to CHOP position. The electronic switch will now chop the signals at approximately 50 Kc rate. Switching transients will automatically be blanked for a clean, undistorted display.

The dual-trace display applications include comparisons of the input and output of the amplifiers, multivibrators, shaping circuits, comparative phase and time delay measurements, etc.

Do not use internal triggering when in the chopped mode, since the random switching transients will cause poor synchronization of the sweep.

2-10. DUAL-TRACE TRIGGERING

a. Introduction

For simplicity of operation, dual-trace triggering may be categorized as follows:

1. External triggering using alternate or chopped modes of operation.
2. Internal triggering using the alternate mode.
3. Internal triggering using the chopped mode.

b. External TRIG Using CHOP or ALT Modes

For dual-trace operation, it is preferable to trigger the time base with an external signal which bears a fixed time relationship to the applied signal. One of the applied signals may normally be employed as the external triggering signal. When this technique is used, a stable display is more readily obtained, and the true time or phase relationship of the two signals is discernible.

In low-frequency applications, one of the applied signals may be used as the external triggering signal. In general, useful stable displays may be obtained by this technique without excessively loading the signal source. However, in high-frequency applications, such a method for deriving the triggering signal, loads down the signal source resulting in an unsatisfactory display. Therefore, a nonloading method must be used for obtaining the external trigger. For example, if the Fairchild Type 781 Time-Mark Generator is the signal source, use the TRIGGER OUT pulse from this generator to externally trigger the oscilloscope.

c. Internal TRIG Using ALT Mode

Internal triggering of the time base may be used if the time or phase relationship between the two signals is not critical. In alternate mode of operation, the signal applied to the Type 702 internally triggers the time base which in turn switches the channels at the completion of each sweep cycle during the retrace intervals.

Hence, it is important to set the TRIG LEVEL control to a point where the sweep can trigger on the signal applied to each channel. If one of the applied signals possesses a smaller amplitude than the other, then the TRIG LEVEL control must be set for reliable triggering on the smaller amplitude signal to insure the successful operation of the alternate mode switching cycle. Also, to avoid triggering on the change in dc positioning level between channels, set the Time Base Coupling switch to AC or LF REJECT.

d. Internal TRIG Using CHOP Mode

For dual-trace, chopped-mode operation, reliable internal triggering may be obtained when the repetition rate of the applied signals is coincident with the chopping rate. If this latter condition is not met, the time base will endeavor to trigger on the composite chopping-rate signal rather than on the applied signals. In this instance, a stable display may sometimes be obtained by carefully setting the TRIG LEVEL control to the point where best triggering with minimum jitter is noted. Also use LF REJECT COUPLING.

2-11. ADDITIONAL HINTS

In addition to the information given in the preceding paragraphs, observe the following precautions when applying signals to the oscilloscope:

1. Avoid errors in readings due to stray coupling between circuits, particularly in the signal lead. As a rule, do not use long, unshielded leads for applying signals to the oscilloscope. This fact holds for the audio-frequency spectrum, except possibly when making measurements on low impedance circuits at very low frequencies. Coaxial or shielded input cables are recommended for most applications.
2. In broadband applications, it may be necessary to terminate a coaxial cable with a resistance equal to its characteristic impedance. This is done to prevent standing waves or ringing (high-frequency damped oscillations).
3. To avoid erroneous results, the operator should simulate the actual operating conditions of the equipment being tested. For example, the equipment should work into a load impedance equal to that which it will see in actual use.
4. Consider the effect of loading upon the signal source due to the input impedance of the oscilloscope. The input impedance can be represented by a resistance shunted by a capacitance. The effective value of this impedance is indicated in the Specifications in Section 1. However, the operator should be aware that even with a few feet of cable in the input circuit, the loading capacitance on the circuit under investigation might be greater than 100 pf.
5. There are cases when connecting the input of the oscilloscope to a signal source, the effect of loading the source is not negligible. To minimize this loading and therefore obtain a valid measurement, a probe may be used in the manner described in the paragraph entitled "Use of Probes".
6. Care must be exercised when applying a fast rise, high-frequency signal to the Input connector. It will be necessary to match and properly terminate the coaxial cable applying the signal to the oscilloscope.
7. As the length of the cable is increased, the necessity for proper termination becomes very important. This termination is generally inserted at the oscilloscope end of the cable, although many signal sources may require an additional termination at the other end of the cable. The Type 4285A Termination is recommended for 50-ohm systems.

For rack-mounting systems, observe the following precautions if long shielded cables are used.

1. It may be desirable to ground long shielded leads only at one end to avoid circulation currents. Even microamperes of extraneous currents in the shielded braid will cause unwanted distortions.
2. Use cable with insulation over the shielded braid so that the cable shield does not accidentally touch ground.
3. Use off-ground insulated bulkhead feed-thru connectors where applicable.
4. Do not pass cables near strong ac magnetic fields.
5. Long shielded input cables may also induce parasitic oscillations. It is suggested that a 100-ohm to 1000-ohm, ½-watt resistor be connected in series with the center conductor near or at the oscilloscope input terminals.
6. Use a resistance at least twice that required to just stop the parasitic oscillations. Too large a value may reduce the bandwidth of the system.

2-12. USE OF PROBES

An attenuator probe lessens both the capacitive and resistive loading caused by the oscilloscope to a minimum value. Simultaneously, while isolating the oscilloscope from the signal source, it reduces the effective sensitivity of the instrument. In other words, the displayed waveform will be reduced in amplitude by the attenuation factor of the probe. The attenuation introduced by the probe permits measurement of signal voltages in excess of those which may be accommodated by the instrument.

When using a probe to sample signals from a tuned, matched, or otherwise critical circuit, capacitive loading may cause erroneous readings. In these cases it may be necessary to remove capacity and resistance from the circuit under observation. When the observations and adjustments are completed, capacitance and resistance precisely equal to that of the probe impedance, should be added to the circuit after the probe is removed from the circuit. This substitution will equalize loading and restore the operating characteristics of the circuit under observation to the same conditions when probe measurements were made.

When using the attenuator probe to make amplitude measurements, multiply the observed amplitude of the display by the attenuation factor marked on the probe.

The Accessory Probe listed in Section 1 of this manual has an attenuation factor of 10 to 1. The maximum voltage that may be applied to this probe is 600 volts dc plus peak ac. Voltages in excess of this value (either dc volts or peak ac volts) may cause damage to components inside of the probe housing.

IMPORTANT: Before using the probe, always check its adjustment.

An adjustable capacitor in the probe compensates for variations in input capacitances from one unit to another. To insure accuracy in pulse and transient measurements, check the probe adjustment frequently. To check the probe, proceed as follows:

1. Connect the probe to the A INPUT connector and apply the probe tip to the 0.5V CAL pin jack on the front panel.
2. Set MODE switch to A ONLY, AC/DC switch to DC and Y VOLTS/CM switch to 10 mV. Adjust the oscilloscope sweep controls to display several cycles of the calibrator waveform.
3. Adjust the variable capacitor in the body of the probe for a flat-top trace on the screen.

To preserve the waveform of the signal being displayed, clip the probe ground lead to the chassis of the equipment being tested. Select a short clean ground point near the probe input connection.

2-13. SWEEP TRIGGERING

To obtain a stable display, the sweep must consistently start at the same point of a repetitive input waveform. If the sweep is not synchronized to the input waveform, the displayed pattern will be traced out at a different point on the screen each time the sweep runs. This will either cause the waveform to drift across the screen or to be unintelligible. The sweep therefore must be triggered by the input signal, or by some signal which bears a fixed time relationship to the input signal. For present purposes, the starting of each horizontal wave across the screen may be called "triggering the sweep." The following instructions tell you how to select and use the proper triggering signal for various applications.

2-14. TRIGGER SOURCE SELECTION

a. Internal

For most applications, the sweep may be triggered by the Y input signal. The only requirement is that the signal amplitude be sufficient to trigger the sweep. To obtain triggering of the sweep from the input signal, set the Trigger Source switch to INT. Internal triggering is convenient since no external triggering connections are required. Satisfactory results are obtained in most applications.

b. External

Sometimes it is advantageous to trigger the sweep with an external signal. External triggering is especially useful where signals are going to be sampled from several different places within an instrument. With external triggering, the triggering signal usually remains constant in amplitude and shape. Thus, it is possible to observe the shaping and amplification of a signal in an external circuit without resetting the oscilloscope triggering controls for each observation. Also, time and phase relationships between the waveforms at different points in the circuit can be seen. For example, if the external triggering signal is derived from the waveform at the input to a circuit, the time relationship and phase of the waveforms at each point in the circuit are compared to the input signal by the displayed waveform.

When a stable, external triggering signal is available, it is possible to observe and accurately measure jitter of the displayed waveform with respect to the trigger input signal. This is not possible when the sweep is triggered internally. Internal triggering will not permit base line to show on screen prior to the rise of the signal being observed. A trigger preceding the signal by more than 300 nanoseconds, may be used to externally trigger the oscilloscope to display the entire signal.

To obtain a stable display, the external triggering signal must have amplitude of at least 0.5 volt, peak-to-peak, and bear a fixed time relationship to the displayed signal. To use an external signal for triggering the sweep, connect the signal to the TRIG IN connector and set the Trigger Source switch to EXT. Also see paragraph entitled "Dual-Trace Triggering."

c. Line

If the pattern on display bears a fixed time relationship to the power-line frequency, the sweep may be triggered by this signal. To accomplish this, set the Trigger Source switch to LINE.

2-15. TRIGGER COUPLING SELECTION

a. AC Coupling

Selection of the AC triggering mode is accomplished by setting the Trigger Coupling switch to AC. This mode is provided with a high-pass filter that has a low-frequency cutoff nominally at 80 cycles. This feature prevents erratic triggering when positioning the pattern vertically while using internal triggering. In the AC mode, triggering is unaffected by the dc components of the triggering signal or by the vertical positioning of the trace. The triggering level can be selected to provide the desired display via use of the TRIG LEVEL control.

When using the AC mode, the Trigger Coupling switch is set to AC. The trace always starts at the same point on the *Waveform* for a given TRIG LEVEL control setting regardless of the vertical positioning.

Note: AC coupling triggering on the line-frequency calibrator signal or square wave signals less than 100 cycles may be erratic since the 80-cycle cutoff filter severely differentiates the trigger. DC coupling is recommended for these signals.

b. DC Coupling

The DC mode is especially useful for viewing waveforms which change very slowly and which are therefore discriminated against by the low-frequency cutoff of the AC position (80 cps). Because of the coupling network time constant in the AC mode, signals having random repetition rates are sometimes viewed more stably in the DC mode.

This mode permits excellent triggering on all types of waveforms and is most useful in the following applications:

1. For optimizing trigger sensitivity or operation when low-frequency signals are applied;
2. For maintaining the initial reference position of the trace with respect to the CRT scale at a given TRIG LEVEL control setting when on Internal Source; and
3. For avoiding trigger point variations due to random repetition rate triggering signals.

When using the DC mode, the Trigger Coupling switch is set to DC. The trace always starts at the same point on the *Scale* for a given setting of the TRIG LEVEL control regardless of the vertical positioning.

c. LF REJECT Coupling

The LF REJECT mode is a special high-frequency form of the AC mode and is used to reject low-frequency components such as 60-cycle hum in the triggering signal. Use AC triggering unless low-frequency rejection is required. Triggering signals with frequency components below 15 Kc may not initiate the sweep circuits when the LF REJECT mode is used.

Note: The LF REJECT mode will provide more stable triggering when this dual-trace oscilloscope is set up for ALTernate Sweep mode and using INTernal triggering source. The LF REJECT mode reduces the effects of a difference in positioning level of the two channels on triggering stability.

Occasionally it is required to obtain stable triggering from a complex high-frequency waveform that contains undesirable low-frequency noise or line-frequency components. In such cases, the additional noise and line pickup may make it difficult to obtain a stable display. If this occurs, select the LF REJECT triggering mode, thereby eliminating the effects of these undesired components. The low-frequency components are blocked from the triggering circuit while the high-frequency triggering waveform is passed to produce the stable triggering that is required. In all other respects, the LF REJECT triggering mode is identical to the AC mode.

2-16. TRIGGER SLOPE SELECTION

When the Trigger Slope switch is set to +, the sweep is triggered on the rising or positive slope of the excitation signal. When the Trigger Slope switch is set to −, the sweep is triggered on the falling or negative slope of the excitation signal.

2-17. TRIGGER LEVEL SELECTION

The TRIG LEVEL control permits selection of a specific voltage which the triggering signal must exceed before the sweep fires. When the Trigger Slope switch is set to the + position, adjustment of the TRIG LEVEL control makes it possible to trigger the sweep consistently on the positive slope of the excitation signal. Conversely, with the Trigger Slope switch set to the − position, adjustment of the TRIG LEVEL control makes it possible to trigger the sweep consistently on the negative slope of the excitation signal.

2-18. SWEEP OPERATIONAL MODES

a. Introduction

When the Trigger Mode switch is set to NORMAL, the oscilloscope may be set up for triggered or automatic sweep. In the SINGLE mode, the time base moves but one stroke until manually reset.

b. Automatic Sweep

When using the AUTO mode, a horizontal reference trace will appear on the screen even in the absence of an input signal. This AUTOmatic mode is very useful while testing equipment since a reference trace will always be visible regardless of whether a signal is applied to the oscilloscope or not.

The AUTO mode simplifies synchronization of signals or periodic waveforms having repetition rates greater than 50 cycles.

To obtain AUTOmatic sweep operation, set the TRIG LEVEL control fully clockwise to AUTO (switch is actuated) and the Trigger Mode switch to NORMAL.

c. Triggered Sweep

A stable pattern for practically all types of signals can be obtained by using triggered sweep. Its use is mandatory for viewing random or non-periodic signals having low repetition rates. Use of the triggered sweep mode of operation in the majority of applications is the preferred condition under which optimum triggering performance can be expected of this instrument.

When the oscilloscope is set for anything other than X amplifier, the spot will be visible only during forward sweep time. The INTENSITY control must be properly adjusted to make the sweep visible. For triggered sweep operation, proceed as follows:

1. Apply the desired signal to A or B INPUT connectors and set front-panel controls as previously indicated in Figure 2-5.

2. Adjust Y PULL VARIABLE control in conjunction with Y VOLTS/CM switch to obtain a vertical deflection of approximately 5 centimeters.
3. Adjust TRIG LEVEL control to initiate the sweep and the POSITION controls to center the display.
4. Rotate the TIME/CM and PULL VARIABLE controls to obtain the desired display. Readjust the TRIG LEVEL control if necessary.
5. Adjust INTENSITY and FOCUS controls to obtain a sharp trace of suitable brightness.
6. If there is any multiple triggering of the sweep, the TRIG LEVEL control may be adjusted to select the signal levels which will best actuate the trigger circuit. Thus, undesirable signals of lesser amplitude will be rejected by the trigger channel.
7. Set Trigger Coupling switch to LF REJECT to obtain a more stable display when using high-frequency triggering signals. Use DC coupling when the triggering waveform is very low.

d. Single Sweep Operation

Single sweep operation means that the time base moves but one stroke until reset. Using a repetitive sweep to view a varying waveform would result in an overlapped and unintelligible display caused by many cycles of the single trace being superimposed on one another. However, when it is desired to view a single display of an input signal which continually varies in amplitude, shape, or time, the Trigger Mode switch should be set to SINGLE for single sweep presentation. Thus, by commanding but one stroke of the sweep at a time, the SINGLE position eliminates the overlapping caused by the multiple traces and enables the display to be viewed and/or recorded clearly.

A single trace will sweep across the screen each time the sweep is triggered and at the end of its travel, the beam will rest off screen. To rearm the sweep, set the Trigger Mode switch from SINGLE to NORMAL and back to SINGLE position. The sweep is now armed and ready to fire on the next trigger.

Note: Do not use AUTOmatic triggering or have continuous input of triggers since single sweep will not reset or function properly.

For manual single-shot operation, proceed as follows:

1. Set Trigger Mode switch to NORMAL and Trigger Source switch to INT.
2. Adjust TRIG LEVEL control until sweep just disappears.
3. Set Trigger Mode switch to SINGLE.
4. Flip Trigger Polarity switch up and down; sweep will fire once. (Rocking the TRIG LEVEL control will also cause the sweep to fire just once.)
5. Reset Trigger Mode switch to SINGLE.
6. Repeat steps 4 and 5 for controlled manual single-shot operation.

2-19. SWEEP EXPANSION

a. Uncalibrated

If the EXPANDER X VERNIER control is not set either fully CW or CCW (switch is not actuated), continuous expansion about the center of the screen from 1 to 10 times may be obtained. Any full scale portion of the expanded trace may be positioned on screen.

b. Calibrated

When the EXPANDER X VERNIER control is set to CAL X1 (click is heard when switch is actuated) the sweep rate is that indicated by the setting of the TIME/CM switch.

The CAL X10 setting of the EXPANDER X VERNIER switch (click is heard) provides horizontal magnification of the internal sweep about the screen center by a factor of 10. Thus, the fastest sweep rate is extended to 0.5 microsecond/cm. Any portion of the expanded display may be observed by adjusting the POSITION control.

When the instrument is set up for sweep expansion, the sweep rate indicated by the setting of the TIME/CM control must be divided by the expander factor of 10 to obtain the actual time required for the spot to move one centimeter. The expanded sweep rate may be expressed as follows:

$$\text{Expanded Sweep Time/Cm} = \frac{\text{TIME/CM setting}}{10}$$

For example, if the TIME/CM control is set to 10 mSEC, and the EXPANDER X VERNIER switch is set to CAL X10, the actual time per centimeter is 10 milliseconds, divided by 10, or 1 millisecond per centimeter.

$$\text{Or using the formula: } \frac{10 \text{ msec/cm}}{10} = 1 \text{ msec/cm}$$

2-20. INTENSITY (Z AXIS) MODULATION

The Type 7088 Z Axis Modulation option is available as an accessory for intensity modulation of the trace. Installation instructions are furnished with each kit.

Negative pulses to the grid of the cathode-ray tube will blank the trace. Pulse amplitude of more than 25 volts is required into an impedance of approximately 600K ohms coupled via a 3300 picofarad capacitor to dim the trace.

2-21. X-Y DISPLAYS

When desiring to view one voltage plotted against another (not the internal time base), simply connect the signals to the X and Y Input terminals and ad-

just the oscilloscope controls to obtain an appropriate display on the cathode-ray tube screen. The TIME/CM control must be set to one of the two X V/CM settings (1 or 10) for X-Y display.

CAUTION

KEEP INTENSITY LOW

Screen damage can result from too intense a beam resting at one point on the screen.

2-22. VOLTAGE MEASUREMENTS

NOTE

When making voltage measurements, make sure there is a common ground between the oscilloscope and the signal source.

a. General

This oscilloscope may be used to measure the voltage of the input signal by using the calibrated Y VOLTS/CM setting and observing the height of the display on the screen in centimeters.

When making voltage measurements, the operator should try to set up the instrument for full scale vertical deflection to insure maximum accuracy. Also, it is important to remember that the width of the trace may be an appreciable part of the over-all measurement. This is particularly true when you are measuring signals of small amplitude or when stray signal pickup has broadened the trace. The operator should consistently make all measurements from one side of the trace. If the top side of the trace is used for one reading, it should be used for all succeeding readings.

b. How to Measure Peak-to-Peak Voltages Using the CRT Scale

The procedure employed for all voltage measurements is basically the same. The PULL VARIABLE control must be set to CAL (pushed in). The specific examples that follow are intended to show the general procedure. These examples may be adapted to fit any particular application.

To measure the ac component of the signal on display, set the AC/DC switch to AC. In this position, only the ac components of the input signal are displayed on the screen. However, when the ac component of the input is of very low frequency (under 20 cps), set the slide switch to DC to prevent errors. To make measurements, proceed as follows:

1. Using the calibrated scale, measure the vertical deflection in centimeters from the positive peak to the negative peak of the waveform. See Figure 2-7.

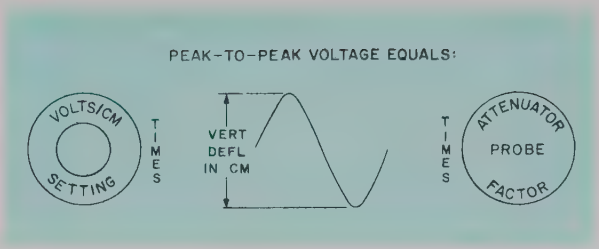


Figure 2-7. Peak-to-Peak Voltage Measurements

2. Multiply the vertical dimension obtained in step 1 by the Y VOLTS/CM control setting to obtain the indicated voltage.

3. Multiply the indicated voltage obtained in step 2 by the attenuation factor of the probe, if one is used, to obtain the actual peak-to-peak voltage.

For example, suppose that you are using a 10:1 Attenuator Probe and the Y VOLTS/CM control is set to 0.1. Assume that the vertical distance between the peaks of the waveform measures 4 centimeters. Now, the vertical dimension of 4 centimeters is multiplied by the Y VOLTS/CM setting of 0.1 to give 0.4 volt. Next, multiply this result by 10, the attenuation ratio of the probe. This gives 4 volts as the peak-to-peak voltage of the display waveform.

Note: Always make sure that the PULL VARIABLE control is pushed in when making measurements.

c. How to Measure Instantaneous Voltages with Respect to Ground (or Some Other Reference Potential) Using the CRT Scale

The technique used for measuring instantaneous voltages with respect to a reference point, is virtually the same as that described for peak-to-peak voltage measurements. The difference is that now a reference point must be established on the screen of the oscilloscope. Since voltage measurements with respect to ground are the most common, the procedure which follows establishes ground as the reference point. The same general technique may be used for instantaneous measurements with respect to any other potential, just so long as that potential is employed to establish the reference point.

To make measurements, proceed as follows:

1. Set the AC/DC switch to DC.

2. Adjust the appropriate controls to obtain a reference trace. (Use Auto Triggering.)

3. To establish the reference point, touch the probe tip to the ground terminal on the oscilloscope (or to the desired source potential, if a point other than ground is used). Position the trace vertically to a convenient point on the screen. This point should be chosen so that it lies on one of the major horizontal scale divisions. The chosen horizontal scale line,

which is now coincident with the trace, is the reference line from which all voltage measurements are to be made.

4. Disconnect the probe tip from ground and connect it to the signal source without disturbing the POSITION control.

5. Adjust the oscilloscope controls for a suitable and stable display.

6. Using the calibrated scale, measure the number of graticule divisions from the desired point on the waveform to the pre-established reference line set up in step 3. See Figure 2-8.

7. Multiply the vertical dimension obtained in Step 6 by the Y VOLTS/CM control setting to obtain the indicated voltage. Make sure that the PULL VARIABLE knob is pushed in.

8. Multiply the indicated voltage obtained in Step 7 by the attenuation factor of the probe used to obtain the actual instantaneous voltage.

For example, suppose that you are using a 10:1 Attenuator Probe and the Y VOLTS/CM control is set to 0.1. Assume that the vertical distance between the desired point on the waveform to the pre-established reference line is 4 centimeters. Now, multiply this vertical deflection of 4 centimeters by the Y VOLTS/CM setting of 0.1 to give 0.4 volt. Next, multiply this result by 10, the attenuation factor of the probe. This shows that the instantaneous voltage with respect to ground to be 4 volts. Since the voltage point is above the reference line, the indicated polarity is positive.

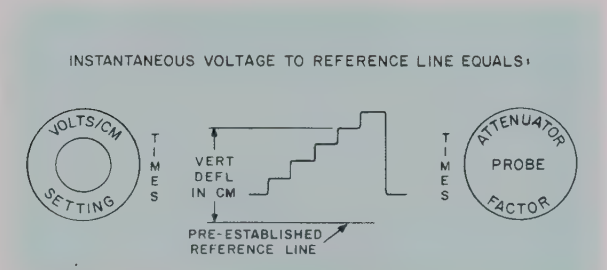


Figure 2-8. Instantaneous Voltage Measurement with Respect to Ground (or Some Other Reference Potential)

2-23. TIME MEASUREMENTS

a. How to Make Elapsed Time Measurements Using the CRT Scale

Any horizontal distance on the screen of the oscilloscope can be used to represent a precise interval of time when the time base circuits are set up for calibrated sweep (PULL VARIABLE control "in"). Use of this feature permits you to accurately measure the elapsed time between the desired point of interest on the display. To insure the time interval, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in centimeters between that portion of the display whose time interval you wish to find.

2. Multiply the horizontal dimensions obtained in Step 1 by the TIME/CM control setting to obtain the time interval. See Figure 2-9.

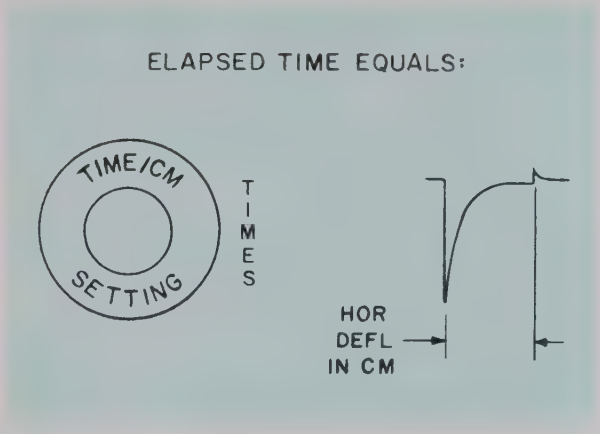


Figure 2-9. Elapsed Time Measurements

b. How to Find Repetition Rate or Frequency Using the CRT Scale

The repetition rate or frequency for periodic signals can be expressed as the number of cycles or pulses per unit of time. To use the oscilloscope for measuring the repetition rate or frequency of periodic signals, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in centimeters occupied by one cycle of the display under observation.

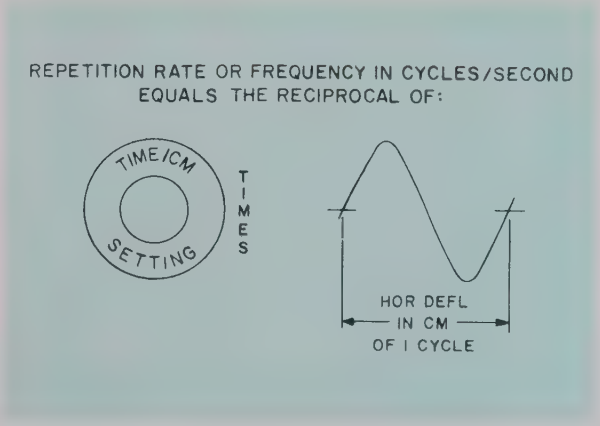


Figure 2-10. Finding the Frequency

2. Multiply the horizontal dimension obtained in Step 1 by the TIME/CM control setting.

3. Take the reciprocal of the product obtained in Step 2 (that is, divide it into one). The resulting quotient is the desired frequency or repetition rate in cycles per second. See Figure 2-10.

$$\text{Cycles/second} = \frac{1}{\text{Time (seconds)}}$$

2-24. RISE-TIME MEASUREMENTS

Application of signals from an external time calibrator will facilitate pulse rise-time measurements. When making such measurements, the one factor which must be borne in mind for most accurate quantitative results is the pulse response characteristic of the vertical amplifier. This characteristic is related to the observed pulse rise time and the actual pulse rise time in the following manner:

$$t_p = \sqrt{(t_o)^2 - (t_a)^2}$$

Where: t_p = actual pulse rise time in microseconds
t_o = observed time of pulse displayed on oscilloscope in microseconds
t_a = amplifier rise time in microseconds

Once the amplifier rise time is known (see Specifications), the rise time of any pulse may be calculated.

To make rise-time measurements, proceed as follows:

1. Adjust pattern for full scale (10 cm) of vertical deflection.

2. Using the X and Y POSITION controls, adjust the display vertically so that the start of the waveform rests 1 centimeter below the scale horizontal center line and the rising portion of the waveform intersects the zero point on the scale (labeled A in Figure 2-11). Observe that the top of the waveform is off screen. Be careful not to accidentally change the setting of the X POSITION control.

3. With the Y POSITION control, move the waveform down until the top portion of the waveform rests 1 centimeter above the horizontal center line.

4. Note where the rising portion of the waveform intersects the X axis (labeled B in Figure 2-11).

5. Measure the distance between points A and B; multiply this reading by the TIME/CM switch setting to obtain rise time.

6. For example, if the distance between points A and B is 3 centimeters and the TIME/CM switch is set to 5 μs, the rise time would be 15 μs.

7. Rise-time measurements made in this manner eliminate errors which would result from improper deflection plate alignment and incorrect interpolation.

8. Rise time of the amplifier may be checked by applying a pulse with an input rise 5 or more times faster than the amplifier. (Use Fairchild Type 791 Square Wave Generator.)

2-25. PHASE SHIFT MEASUREMENTS

Phase shift measurements are usually made when the frequencies of the two input ac signals are equal. Hence, Lissajous figures that result from a phase difference between two input signals of the same frequency are often referred to as phase difference patterns. When using very low frequency sine waves, dc coupling should be used to eliminate phase shifts due to the coupling circuits.

To check the relative phase shift, proceed as follows:

1. Apply one sine wave signal to X INPUT and the second signal to Y INPUT.

2. Center the trace horizontally and adjust the Y controls for 10 centimeters of vertical deflection. The pattern obtained should be similar to Figure 2-12.

3. The angle between the two signals is that angle whose sine is the ratio A/B.

Note: To obtain full scale vertical deflection of 10 centimeters, it may be necessary to temporarily reduce the horizontal amplitude of the display. To accomplish this, set the X VOLTS/CM switch one step counterclockwise from its initial setting. Adjust the display for 10 centimeters of vertical deflection. Reset X VOLTS/CM switch to its original setting; recenter the display, and read dimension A in Figure 2-12.

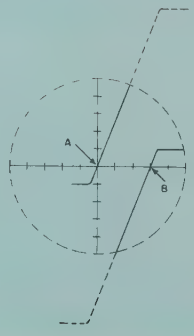


Figure 2-11. Rise-Time Measurement

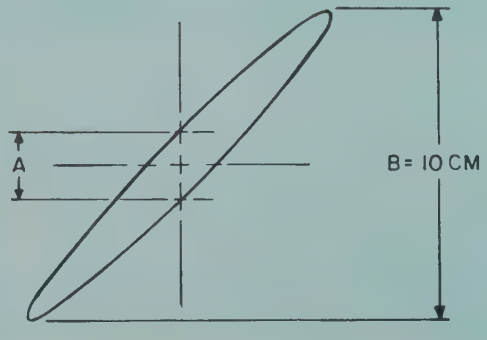


Figure 2-12. Phase Shift Measurements

NOTES

NOTES

SECTION 3
CIRCUIT DESCRIPTION

3-1. INTRODUCTION

To simplify circuit description of the Type 702 Dual Trace Oscilloscope, functional block diagrams are provided as follows:

Figure 3-1. Type 702 Channels A & B Pre-amplifier, Functional Block Diagram

Figure 3-2. Type 702 Electronic Switch & Y Deflection Amplifier, Functional Block Diagram

Figure 3-3. X Input Circuit, Simplified Functional Block Diagram

Figure 3-4. X Deflection Amplifier, Functional Block Diagram

Figure 3-5. Trigger Circuit, Functional Block Diagram

Figure 3-6. Sweep Generator, Simplified Block Diagram

Refer to Figure 5-1 in the Maintenance and Recalibration Section for the over-all system block diagram.

The circuit description will be keyed to the above-mentioned illustrations. Emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of this manual be referred to in following the circuit description.

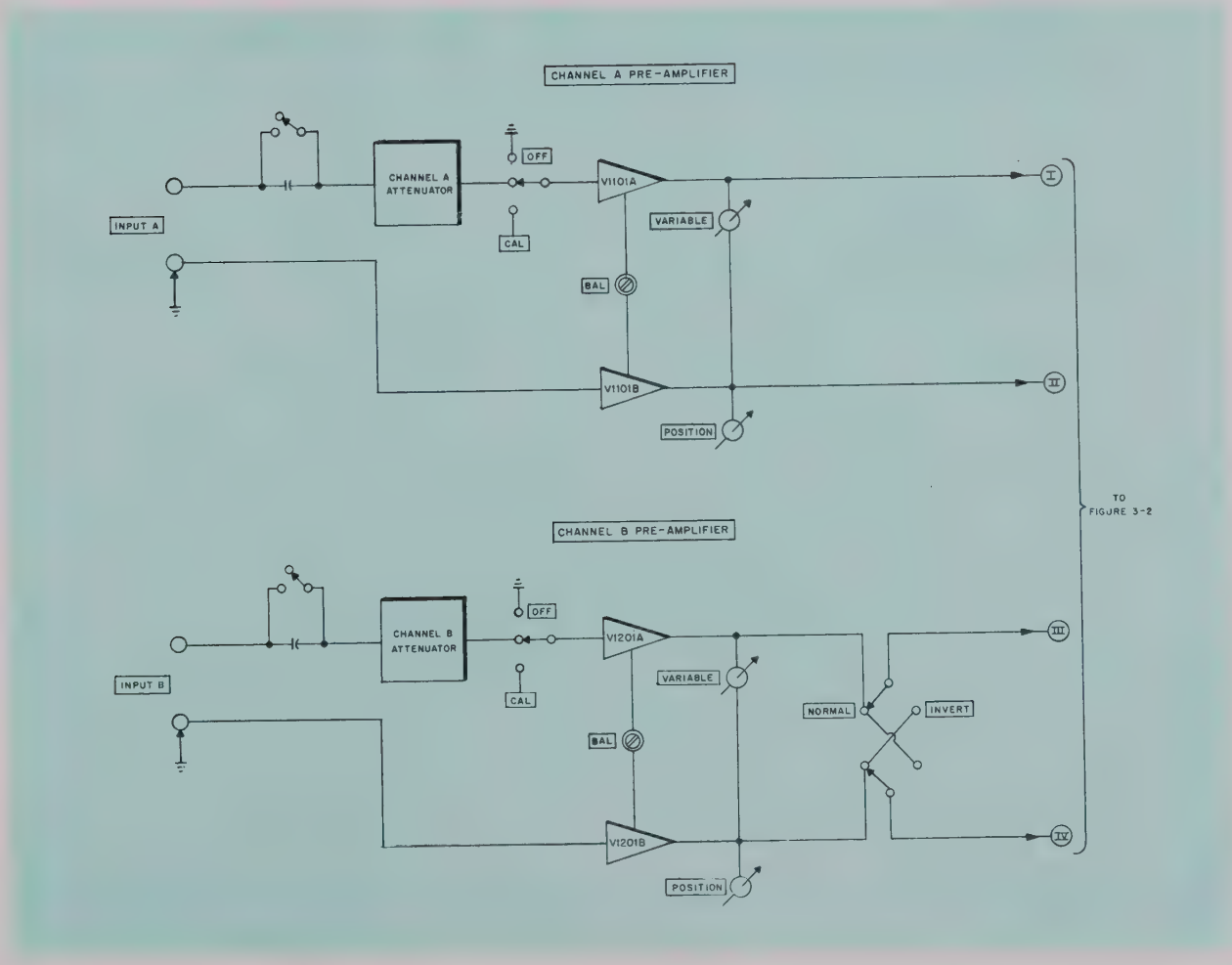


Figure 3-1. Type 702 Channels A & B Pre-Amplifiers, Functional Block Diagram

3-2. INPUT AMPLIFIER CIRCUIT DESCRIPTION (Figure 3-1)

a. Input Channel

The Type 702 input system consists of two identical input channels (Channel A and Channel B), an electronic switching system, and a common vertical deflection amplifier. The output of either or both input channels may be applied to the common vertical deflection amplifier depending on the setting of the MODE Selector switch.

Each input channel consists of an attenuator and a pre-amplifier. Since the input channels are identical, the circuit description will refer to Channel A only. Operation of Channel B will be the same as Channel A except where otherwise noted.

A two-position slide switch (AC or DC) permits choice of retaining the dc level of the input signal or blocking the dc component of the input signal by inserting a capacitor in series with the input.

The Y VOLTS/CM switch permits the desired attenuation of the input signal from 10 millivolts/cm to 10 volts/cm in 4 decade steps. In the CAL position, the calibrator signal is applied to the grid of the input amplifier V1101, and may be used to normalize the oscilloscope. When gains are normalized, the peak-to-peak value of the calibrator waveform will indicate 5 centimeters of vertical deflection on the screen.

An OFF position is provided on the Y VOLTS/CM switch to facilitate the dc balancing of the input amplifier.

b. Pre-Amplifier Operation

The normally grounded grid of V1101B (pin 7) is brought out to the front-panel binding post so that balanced input operation may be obtained by merely removing the ground link.

The RC networks, R1106 and C1107, and R1110 and C1109, in series with the grid of V1101A and V1101B respectively, serve to protect the input circuit from damage due to excessive input voltage. The shunt capacitors preserve the high-frequency signal components.

The PULL VARIABLE control is connected between the cathodes of V1101A and V1101B in the gain control stage, and is deactivated when the knob is pushed in. The front-panel screwdriver BAL control is provided to equalize the cathode voltage of V1101A and V1101B so that there is no depositioning of the trace on the screen when the PULL VARIABLE control is used. To use the VARIABLE control, pull the knob and rotate it for the desired amplitude.

The POSITION control is introduced at the grid of V1102B and allows vertical positioning of the trace. A polarity reversal switch is mechanically linked to the Channel B POSITION control and permits signals applied to this channel to be inverted. If this switch is used when the MODE switch is set to A + B, the unit may be set up for Channel A plus Channel B or Channel A minus Channel B presentation.

3-3. ELECTRONIC SWITCH AND Y AMPLIFIER CIRCUIT DESCRIPTION (Figure 3-2)

a. Blanking Multivibrator

Selection of the input channel whose output is to be applied to the common vertical deflection amplifier, is accomplished by means of the Electronic Switching circuit.

The timing of the electronic switch V1104A and V1104B is provided by the blanking multivibrator V1105A and V1105B. The blanking multivibrator may be switched to either a monostable or a free-running condition by the MODE switch S140. When the MODE switch is set to any position except CHOP, a negative bias is applied through resistors R1421 and R1422 to the grid of V1105B. This action locks the blanking multivibrator in the monostable state with V1105B turned off and V1105A turned on.

When the MODE switch is set to CHOP, this bias voltage is reduced, permitting free-running operation of this stage at a repetition rate greater than 50 Kc. This gating voltage is applied to the electronic switch which alternately functions to turn Channels A and B off and on at a 50-Kc rate, independent of the sweep rate.

External triggering of the time base is to be preferred in the chopped position to prevent triggering of the sweep on the *chopping* signal.

The timing of the blanking multivibrator is determined by the master trigger developed from the output of the sweep gate multivibrator as follows: the positive gate signal developed at the plate of V3501A (pin 6) is applied to cathode follower V3502A. Positive and negative pulses are developed by a differentiator consisting of C1404 and R1412 of which only the negative output is of interest. This negative-going master trigger is coincident with the trailing edge of the sweep gate and is applied through series coupling diode CR1403 to the grid of V1105A, turning it only momentarily. Consequently, one narrow negative pulse is generated at the plate (pin 1) and one narrow positive pulse at the cathode (pin 3) of V1105B. The positive output at the cathode of the blanking multivibrator is applied to series coupling diode CR1404 to the common cathodes of the electronic switch V1104A and V1104B.

When the MODE switch is set to CHOP, (V1105A and V1105B now operates in the free-running mode), the output of the blanking multivibrator is independent of the input triggering signal.

It is necessary to turn off the cathode-ray tube beam during switching in the chopped position. This is ac-

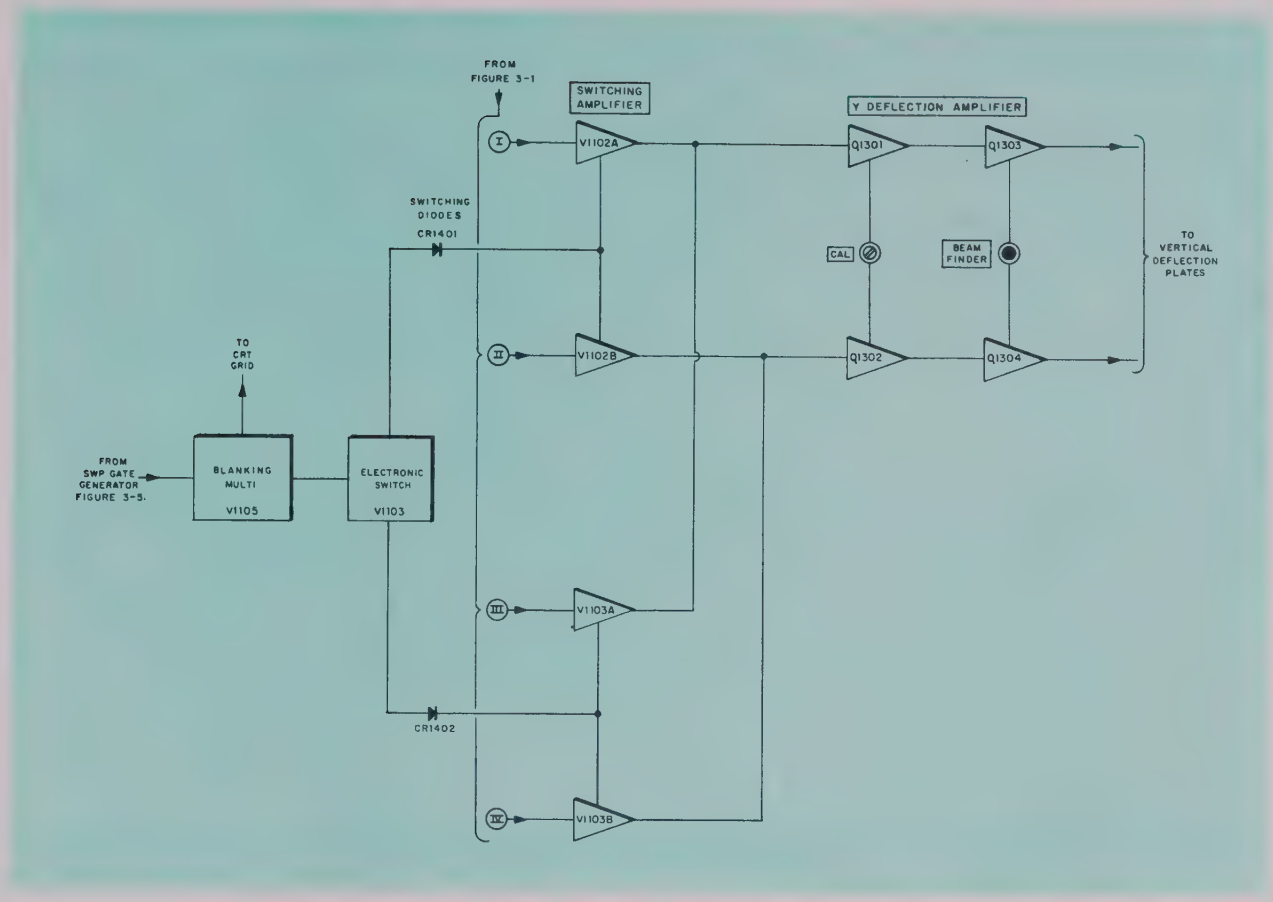


Figure 3-2. Type 702 Electronic Switch & Y Deflection Amplifier, Functional Block Diagram

complished by applying the negative pulse generated at the plate of V1105B (pin 1) to the CRT grid.

b. Electronic Switch

When the MODE switch is set to ADDED, the B+ voltage for the electronic switch V1104A and V1104B is disconnected. This allows both pre-amplifier channels to work simultaneously, thus providing a computer type algebraic adder circuit (no common mode rejection) for Channels A and B.

When the MODE switch is set to either A ONLY or B ONLY, the electronic switch V1104 becomes inoperative and will not respond to the triggering signals from the blanking multivibrator V1105. However, the switching diodes are activated.

For example, when the MODE switch is set to A ONLY, switching diode CR1402 coupled to Channel B preamplifier is forward biased by the application of a positive voltage through R1409. The cathodes of Channel B switching amplifier V1103A and V1103B are raised, thus plunging this stage into cutoff; therefore Channel B is arrested at this point.

Switching diode CR1401 coupled to Channel A preamplifier is reversed biased by its application of a negative voltage through R1407 and R1404. This permits the cathodes of V1102A and V1102B to operate at their normal bias. Hence, only Channel A output progresses to the common vertical deflection amplifier. When the MODE switch is set to B ONLY, just the opposite operating conditions exist.

In the ALT or CHOP positions of the MODE switch, the electronic switch becomes operative and may now be keyed at will by the blanking multivibrator. When the MODE switch is set to ALT, the catode-ray tube displays the signal in one channel for one sweep of the beam, and the signal in the other channel for the next sweep of the beam. In the CHOP position, Channels A and B signals are time-shared at a 50-Kc chopping rate.

c. Common Deflection Amplifier

The output from the channel switching amplifier is applied to common vertical deflection amplifier Q1301 and Q1304. An internal calibrating voltage is

applied to the vertical input dc amplifier when the Y VOLTS/CM switch is set to CAL. This switch automatically disconnects the Y INPUT signal jack from the amplifier when the calibrator signal is applied. The Y CAL front-panel screwdriver control is used to set the calibrated gain of the Y amplifier to the peak amplitude of the calibrator signal (5 cm).

The CAL BAL service adjustment R1125 is provided to normalize the gain between channels. The POSITION BAL service adjustment R1128 permits electrical and mechanical coincidence of the POSITION control.

The Y OUTPUT LEVEL ADJ potentiometer R1325 is provided to set the Y deflection plate voltage to 118 volts (nominal) above chassis ground when the collectors of Q1303 and Q1304 are temporarily shorted together.

The BEAM FINDER is a spring-loaded switch that electrically reduces the output amplifier window and scales down the display. This technique permits location of the display and then allows centering with the POSITION controls.

The BEAM FINDER control is extremely useful for locating the spot or trace under any condition of operation. If no spot or trace appears when the BEAM FINDER button is depressed, only two conditions can cause this: either the INTENSITY control has to be advanced or else the sweep is not running. It may aid the operator to set up the instrument for AUTOmatic triggering in an endeavor to obtain a trace on the screen.

A portion of the signal from Q1304 is applied to a voltage divider R1328 and R1329 and provides an internal trigger signal for firing the time base circuit as desired.

3-4. HORIZONTAL DEFLECTION SYSTEM (Figures 3-3 and 3-4)

The TIME/CM switch provides for the selection of time base or external signals for horizontal deflection. External signals may be applied to the X INPUT terminal for single-ended operation. The time base signal is obtained from the sweep circuit and is applied to the horizontal deflection amplifier when the oscilloscope is set up for internal sweep. The EXPANDER X VERNIER control provides continuous adjustment from X1 to X10 for magnification of the internal time base or of external X INPUT signals. The X BAL front-panel screwdriver control provides for equal expansion of the trace from screen center.

The X OUTPUT LEVEL ADJ potentiometer R2029 is provided to set the X deflection plate voltage to 118 volts (nominal) above chassis ground when the collectors of Q2005 and Q2006 are temporarily shorted together. The horizontal deflection plates are driven directly from the transistorized amplifier Q9205 and Q9206.

3-5. TRIGGER CIRCUIT DESCRIPTION (Figure 3-5)

a. Trigger Input

The input to the trigger amplifier V3001, may be selected from one of three sources via the Trigger Source switch as follows:

1. In EXT position, the signal is obtained from an external source through the TRIG IN front-panel connector.

2. In INT position, the signal is derived from the Y Amplifier.

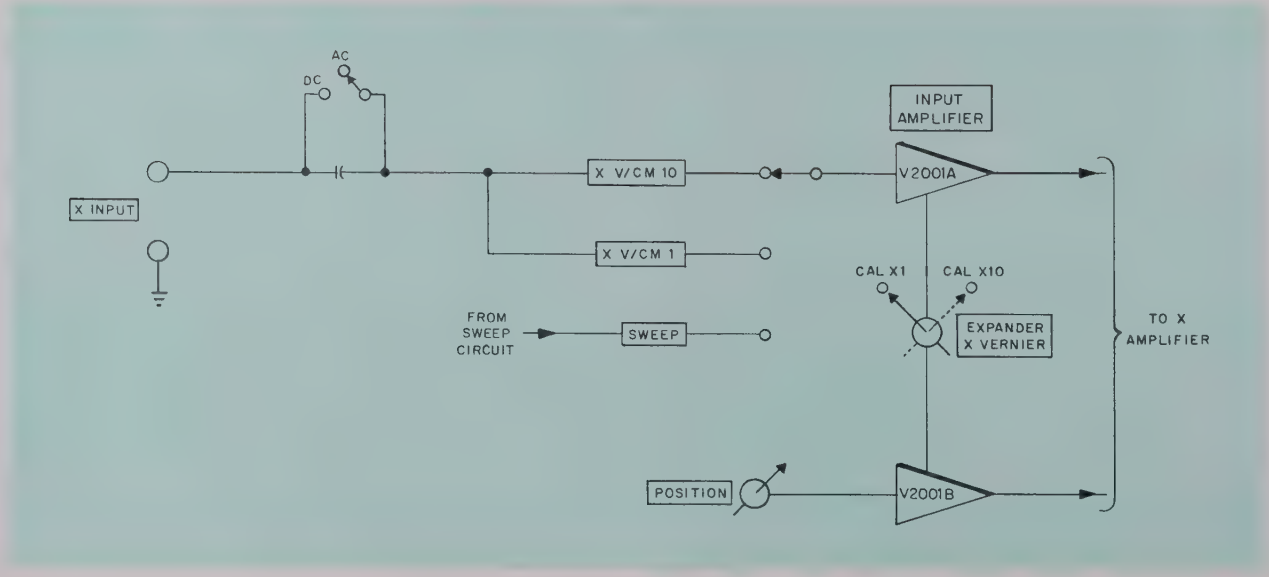


Figure 3-3. X Input Circuit, Simplified Functional Block Diagram

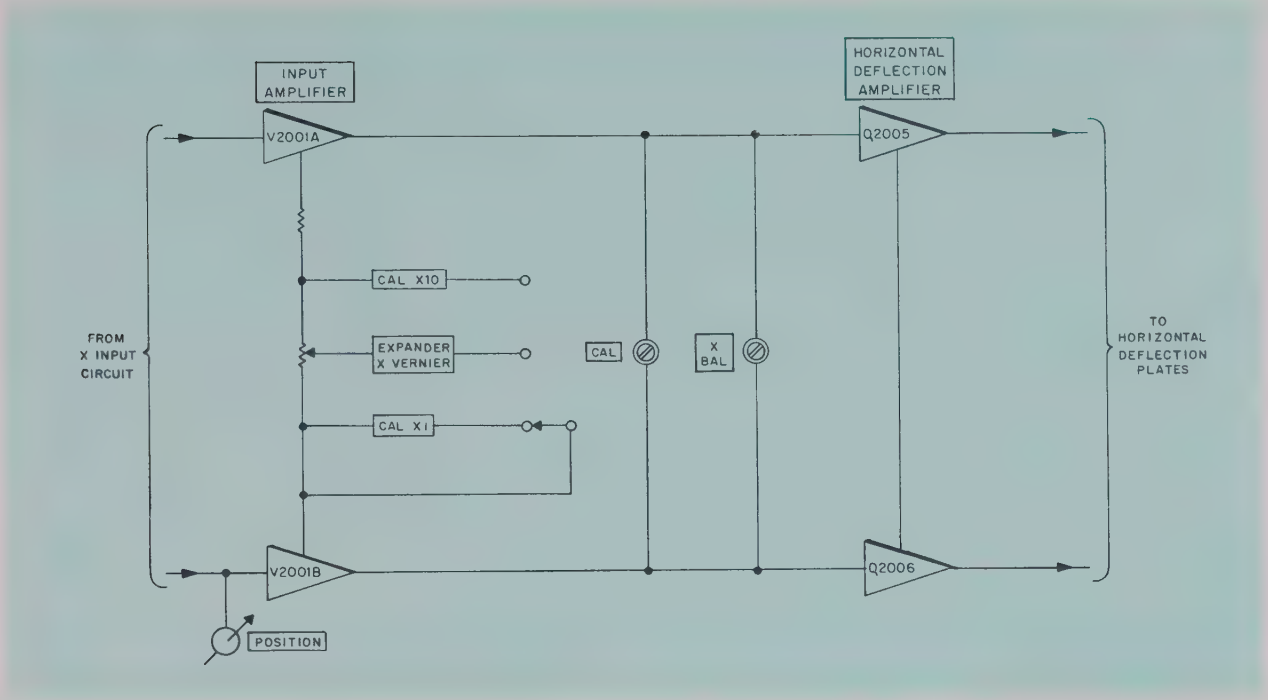


Figure 3-4. X Deflecion Amplifier, Functional Block Diagram

3. In LINE position, the signal is tapped from one side of the 6.3 VAC heater circuit.

A choice of AC, LF REJECT, or DC coupling is provided by the Trigger Coupling switch. In the AC position, the trigger signal is applied to a high-pass filter consisting of C3002, C3003, and R3003 providing a low-frequency cutoff of 80 cycles. The cutoff frequency is raised to 15 Kc in the LF REJECT position and the high-pass filter now consists of C3003 and R3002. In the DC position, the high-pass filters are disconnected and the triggering signal is applied directly to the trigger amplifier. The RC network, R3004 and C3004, in series with the grid of V3001, serves to protect the input circuit from damage to excessive input voltage. Shunt capacitor C3004, preserves the high-frequency signal component.

b. Trigger Amplifier

The trigger amplifier V3001, is a cathode-coupled amplifier. Output is always taken from the B-Section plate (pin 6). For positive-going signals, connection is made to the grid of V3001B (pin 7), and for negative-going signals, connection is made to the grid of V3001A (pin 2). In each case, the opposite grid is connected to a dc bias source, adjustable by means of the TRIG LEVEL control R3006.

The TRIG LEVEL control is used to select the level of the triggering point for both settings of the Trigger Slope switch. When the TRIG LEVEL control is rotated fully clockwise to AUTO, the sweep is self-triggered in the absence of a triggering signal. As you rotate the control away from the AUTO position, the automatic sweep feature will cease. Continued rotation of this control will permit the operator to adjust the triggering level of the pattern within the limits specified in the Performance Specification in Section 1.

c. Schmitt Trigger Generator and Auto Triggering

The Schmitt Trigger Generator is essentially a regenerative signal level detector. It consists of a two-stage amplifier V3002A and V3002B, having a dc plate-to-grid coupling from A to B amplifier and dc cathode-to-cathode coupling. The circuit has two stable states: the A side conducting, the B side at cutoff; the B side conducting, the A side at cutoff. The transition from one state to the other is abrupt, producing fast rise and fall times from each anode in the circuit.

The dc voltage applied to the grid of V3002A determines which state the circuit will be in. Assume operation as follows: V3002A is conducting and V3002B is at cutoff. V3002B will remain at cutoff until the amplitude of a positive-going signal applied to its grid reaches the threshold level of conduction. When this threshold level is exceeded, an abrupt transition from cutoff to full conduction will occur in V3002B. Simultaneously, V3002A is driven to cutoff and will stop conducting. V3002A and V3002B

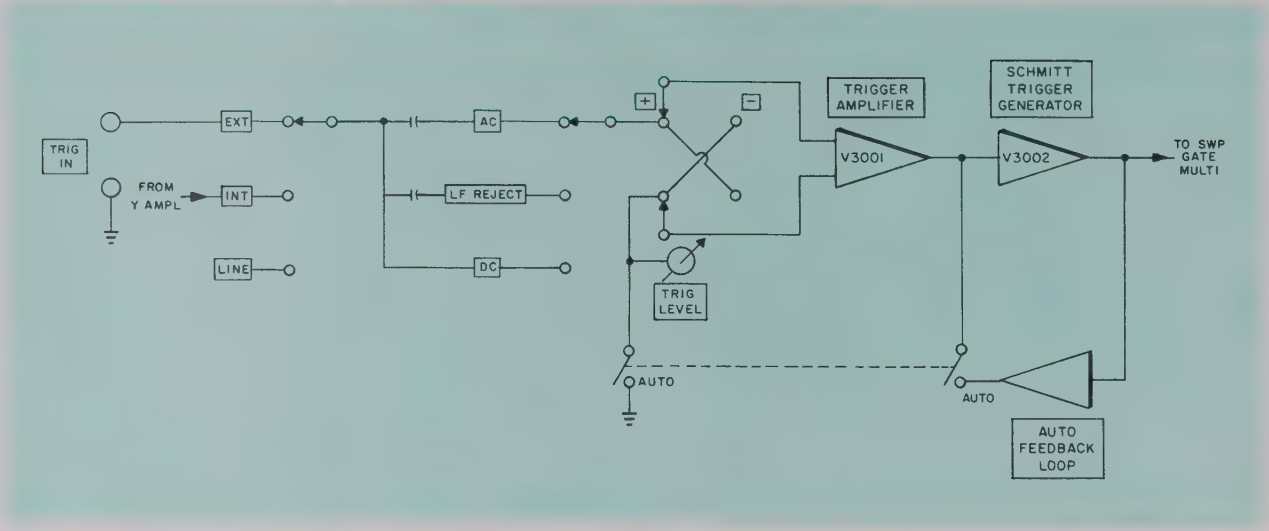


Figure 3-5. Trigger Circuit, Functional Block Diagram

will revert to their original condition when the amplitude of the initiation signal falls slightly below the threshold level of conduction for V3002B.

In general, the threshold voltage is higher when moving the grid in a positive direction, and lower when moving the grid in the negative direction. The two different voltage levels are called the "upper and lower hysteresis limits" of the Schmitt Trigger Generator. The hysteresis offset basically relates to the input peak-to-peak voltage sensitivity of the trigger system.

The initial A-side grid level can be positioned anywhere inside or outside of the hysteresis area, thus establishing the input voltage required to change the state of V3002A. The steady state grid bias of V3002A is normally determined by the TRIG LEVEL control setting.

When the TRIG LEVEL control is set to AUTO, the trigger amplifier is ac coupled to the input grid of the Schmitt Trigger Generator through C3007, and the feedback resistor R3022 is connected between the grids of the Schmitt Trigger Generator. This causes V3002A and V3002B to flip back and forth yielding about 50 pulses per second in the AUTO position. Thus, a horizontal reference trace will appear on the screen even in the absence of an input signal.

3-6. SWEEP CIRCUIT (Figure 3-6)

a. Sweep Gate Multivibrator

The output from the Schmitt Trigger Generator is differentiated by C3009 and R3512 and applied to the grid of V3501A through turn-on diode CR3502.

The dc coupled bistable multivibrator V3501A and V3501B, initiates the formation of the sweep after receiving a negative trigger from the Schmitt Generator. Diode CR3502 and the lockout circuit hold off subsequent triggering signals until after the sweep and retrace are completed. In the quiescent state, V3501A is conducting and V3501B is at cutoff. V3501A forms a positive gate while V3501B forms a negative gate during the forward sweep interval.

CR3502 serves as a low capacitance coupling diode which couples the negative trigger from the Schmitt Generator to the sweep gate multivibrator which flips and initiates the sweep. CR3502 also serves as a high back-impedance diode to decouple the Trigger Generator from the sweep gate multivibrator. After the bistable multivibrator has been triggered, the sweep runs up. When the saw reaches full screen deflection, turnoff diode CR3504 conducts and resets the multivibrator V3501 which then clamps the saw. The sweep LENGTH potentiometer R3536 is adjusted for full screen sweep length display.

b. Saw Generator

The saw generator is of the Miller "run-up" type. The negative output developed at the plate of V3501B is applied to the plates of the disconnect diodes CR3507 and CR3508. The anode voltages of these diodes are now below their cathodes, and the diodes no longer conduct. This action unlocks the integrator clamp and permits the selected sweep capacitor to charge linearly through the associated resistance network.

The grid of the Miller integrator moves negatively when the clamp is unlocked. The plate voltage of V3504 rises positively carrying the saw cathode-follower (V3502B) grid, cathode and timing capacitor in the same direction. A flow of current is required into the charging capacitor if the voltage across this capacitor is to change. The charging current must

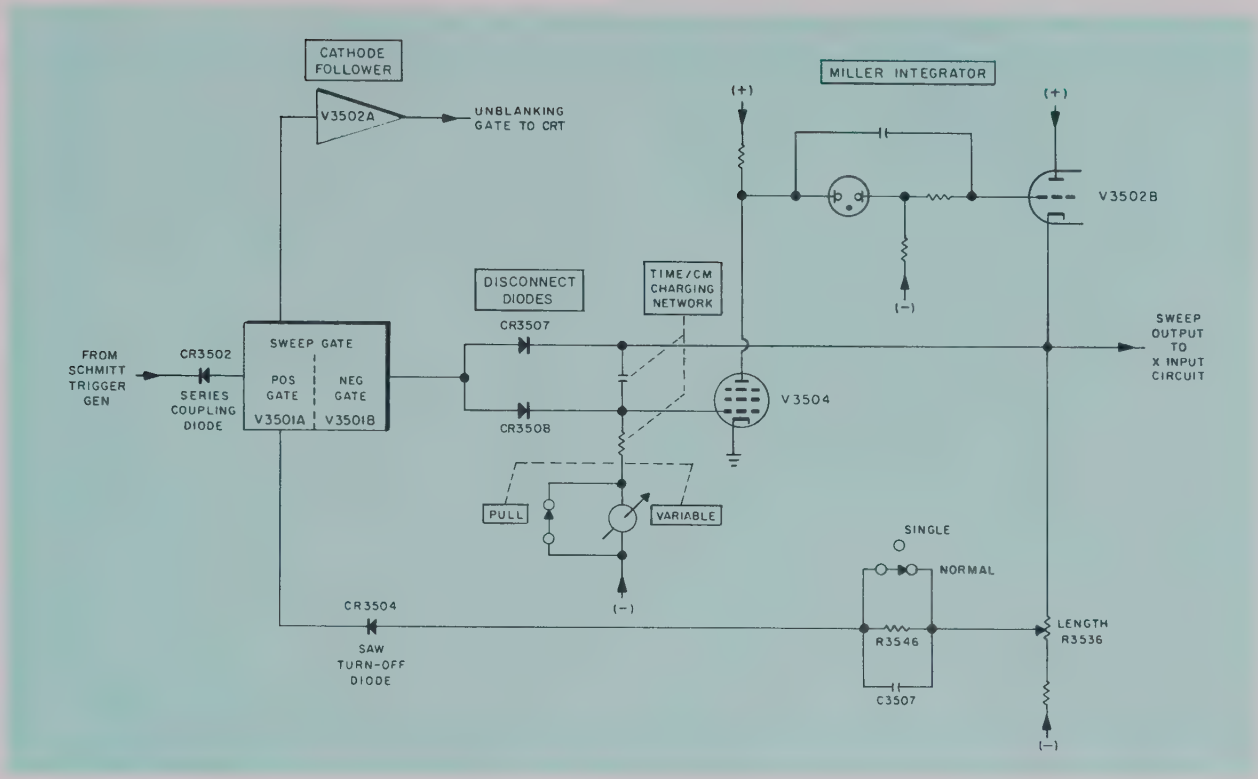


Figure 3-6. Sweep Generator, Simplified Diagram

flow through the charging resistor. The time required to change the voltage across the charging capacitor determines the sweep time.

The positive voltage swing on the opposite side of the timing capacitor tends to prevent the grid side from swinging negatively. It also increases the voltage to which the timing capacitor is trying to charge. The net result is to *straighten out* the charging curve (sweep voltage) by maintaining a constant current flow in the capacitor.

Since the grid of V3504 remains at a constant potential within a small fraction of a volt, the current through the charging resistor remains constant and the sweep timing capacitor thus charges at a constant rate. The resulting linear sawtooth waveform is applied to the horizontal deflection system.

The X EXPANDER VERNIER control provides a calibrated magnification of the sweep about screen center by factors 1 or 10. Any portion of the expanded display may be observed by adjusting the POSITION control.

When a Trigger Mode switch is set to SINGLE, the saw turn-off diode CR3504 is isolated from the LENGTH potentiometer by R3546 and C3507. Thus only a single trace will now sweep across the screen when the sweep is triggered. At the end of its travel, the beam will rest off screen because the sweep gate multivibrator is locked in this position. To reset or rearm the sweep, flip the Trigger Mode switch from SINGLE to NORMAL and back to SINGLE position. Refer to the Operating Instructions Section for application of this technique.

c. Sweep Length

The sweep length, or the total duration of the sweep for any given sweep rate is determined by the setting of the sweep LENGTH adjustment R3536. A portion of the positive sawtooth voltage is fed back to the saw turnoff diode CR3504. If the Sweep LENGTH potentiometer is properly set, diode CR3504 will conduct when the positive-going excursion of the sawtooth has travelled 10.5 to 11 centimeters on the screen. This positive peak signal will then be conducted through diode CR3504 to the grid of V3502A. Upon receiving this positive pulse, the sweep gate multivibrator will revert rapidly to its original state with V3501A conducting, and V3501B at cutoff. The positive step from the plate of V3501 returns the disconnect diodes CR3507 and CR3508 back to their conducting state thus discharging the timing capacitors. The Miller circuit now returns to its quiescent level and is ready for the next sweep cycle after the lockout time interval is completed.

d. Lockout Circuit

The lockout circuit prevents the sweep gate multivibrator from being triggered until the sweep retrace interval has reverted the saw to its quiescent base level. The sweep does not retrace in zero time since the clamping of the Miller integrator timing capacitor is accomplished by a diode switch circuit having a small impedance. The timing circuit discharge (saw retrace) takes longer than the flipping of the sweep gate multivibrator. Consequently, the trigger excitation pulses must be held off to prevent the formation of a new saw during the retrace interval. The sawtooth waveform must be permitted to retrace completely to its quiescent base which reestablishes the beam at the left-hand side of the CRT screen. This is accomplished by holding the cathode of the series-triggering diode CR3502 at a suitable positive voltage for a given period after the completion of the sweep.

During the forward sweep interval, a portion of the positive gate voltage is fed back through R3544 to charge the lockout capacitor through coupling diode CR3501. When the saw reaches its predetermined full screen length, the sweep gate multivibrator flips and clamps the Miller integrator which then causes the sweep to retrace. During the return-trace interval, diode CR3501 is cut off and the lockout capacitor is discharged through R3516. The sweep gate multivibrator will not retrigger until the preselected lockout timing capacitor is chosen to give lockout beyond the time that the sweep has returned to rest at its initial starting point. The duration of the lockout interval is determined by the sweep charging time constant and the Miller integrator clamp. Consequently, the TIME/CM switch must also change the lockout circuit hold-off timing capacity. This technique prevents additional triggers from initiating the sweep gate multivibrator until the sweep retrace interval is completed and the saw reverts to its quiescent state at the left-hand side of the screen.

The trigger coupling diode CR3502 prevents triggers from disturbing the sweep gate multivibrator during all of the sweep-forward interval. The lockout circuitry prevents retriggering during the retrace interval.

e. Unblanking

The cathode-ray tube employed in this oscilloscope has two additional beam deflecting plates which cut off the electron beam independently of the control grid. In beam gate blanking, the electron beam is always turned on and passes through an aperture in the center of a blanking shield. Behind this shield is a set of deflection plates, one of which connected to a fixed +100-volt source, while the second deflection plate is connected to the unblanking gate. When the time base is sweeping both blanking deflection plates are at the same potential and the electron beam passes through the aperture in the blanking shield. When the sweep ends and the unblanking gate voltage increases, the beam is deflected behind the blanking plate and the screen is dark.

Beam control pulses (trace brightening and retrace blanking pulses) can easily be dc coupled since these beam deflection plates are electrically close to ground. In conventional circuits these pulses must be coupled to the control grid which is operated at high potential.

The extra beam deflection plates are controlled by the sweep gate multivibrator V3501. A positive gate is developed at the plate of V3501A and is coincident with the sweep forward time. This pulse is applied to the beam deflection plate of the cathode-ray tube through cathode follower V3502A. Hence, the display is visible only during the forward sweep interval and is blanked during the retrace and lockout interval.

When the TIME/CM switch is set to X V/CM, one side of the sweep gate multivibrator is ungrounded thus disabling the sweep circuit and turning on the beam. The horizontal deflection amplifier may now be set up to display external signals.

3-7. LOW VOLTAGE POWER SUPPLY

a. Power Transformer

Plate and heater power for this instrument is provided by a single power transformer T4001. The primary is wound with two equal 115-volt windings that can be connected either in parallel for 115-volt operation, or in series for 230-volt operation.

b. Regulated Supplies

Regulated supplies are provided with outputs as follows:

+160 volts, +59 volts, and −50 volts

All of these regulated supplies are of the constant-output voltage series-passing type. The basic reference for all of the regulated supplies is the fixed drop across V4004. This gas diode V4004, maintains a constant voltage drop of about 85 volts across itself within a broad current range.

Operation of the other low-voltage regulated supplies is identical, so only the +160-volt supply is described. CR4001 to CR4004 are connected in a conventional bridge rectifier circuit. The rectified output is capacitively filtered by C4001. Resistor R4000 shunts the filter capacitor as a safety measure to leak off the charge when the instrument is turned off.

The filtered rectified output is applied to V4001 series-passing tube whose voltage drop is adjusted by the feedback voltage from R4008R through the dc amplifier Q4001. Assume the output voltage tends to decrease. This will lower the base voltage of the error detector amplifier Q4001. The resulting increase in

voltage at the collector of Q4001 is applied to the control grid of the series-passing tube. The resultant voltage change in the series-passing tube V4001 is such as to return the output voltage to its proper value.

c. Voltage Calibrator

The power-line frequency voltage from T4001 is applied to the base of voltage calibrator Q4007 through limiting resistor R4051. Negative and positive excursions will drive the transistor into and out of conduction at the line-frequency rate. The resulting square wave at the collector of Q4007 is applied to a voltage divider. The attenuated output is coupled to the vertical amplifier when the Y VOLTS/CM switch is set to CAL.

3-8. CRT CIRCUIT

a. CRT Beam Control Circuits

The INTENSITY control R4509, part of the negative high-voltage divider, is used to vary the cathode-ray tube grid voltage to adjust the CRT cathode current. The FOCUS control R4503, varies the voltage at the focusing anode to set the second cross-over point of the electron beam right at the screen of the cathode-ray tube. The ASTIGmatism control R4523 is provided to vary the voltage at the astigmatism anode to optimize the spot shape in both axes.

b. High-Voltage Power Supply

Accelerating voltages for the cathode-ray tube are obtained by rectifying a 50 Kc sine wave voltage produced by a vacuum-tube oscillator. V4501 is the oscillator tube connected as a Hartley oscillator with the primary of transformer T4501 as the tapped inductor and C4511 as the timing capacitor.

The output of the oscillator is stepped up by T4501 and applied to a conventional half-wave rectifier. The rectified output as applied to the cathode-ray tube after being filtered to remove virtually all of the ripple content.

Regulation of the high-voltage negative supply is accomplished by sampling a portion of the rectified output and applying a correction signal back through V4502 to the screen grid of V4501. This action changes the amplitude of oscillations of V4501 and T4501 in such a manner as to restore the high voltage output to its preset level. Potentiometer R4505, HV ADJ, is provided to preset the output of the high-voltage supply to its proper level.

NOTES

SECTION 4
PERFORMANCE ASSURANCE TEST

4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance of the instrument. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 5, paragraph 5-5 for list of test equipment required.

NOTE

If this Oscilloscope is checked by a Receiving Inspection laboratory, the tests outlined below are recommended to certify performance. This instrument has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence, it is suggested that the certifying engineer try the recommended adjustments not only for recentering the controls, but also to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined in the paragraphs to follow, the instrument will not perform to specification, the assistance of the local Fairchild Field Engineering representative should be requested.

4-2. INITIAL SETUP OF TYPE 702 (Figure 4-1)

If the controls are set exactly as shown and performed in the sequence indicated in Figure 4-1, three cycles of the calibrator signal (60-cycle line) will be displayed on screen. The procedure just given is a good, over-all check of the Type 702 Oscilloscope.

4-3. CHECKING THE POWER SUPPLY

1. Check the line fuse located on the front panel for proper value (2 amperes).
2. Open the covers and carefully inspect the instrument; correct any visible defects.
3. Apply power to the instrument through a variable voltage source (Variac, or an equivalent). Set the line voltage to 115 volts. (Double this value for 230-volt operation.)
4. Set up the oscilloscope to obtain three cycles of the calibrator signal.
5. Allow 30 to 60 minutes for warmup before making any final adjustments.
6. Lower the line voltage until the display starts to drift or become erratic. The line voltage must be less than 105 volts at 60 cycles (210 volts for 230-volt operation). If instability is noted before the lower limit of the line voltage is reached, check operation of the low-voltage regulated power supplies as outlined in Section 5 of this Instruction Manual.
7. Raise the line voltage to 125 volts (250 volts for 230-volt operation). The display should remain stable and must not be erratic. If instability is noted before the upper limit of the line voltage is reached, check operation of the low-voltage power supplies.
8. Reset the line voltage to 115 volts (230 volts for 230-volt operation).

4-4. CHECKING CHANNELS A & B VOLTS/CM SWITCHES

1. Connect the output of a Ballantine Type 420 Calibrator, or equivalent, to Y INPUT connector on the Type 702 Oscilloscope.
2. Refer to accompanying Amplitude Check Calibration Chart for additional data.

AMPLITUDE CHECK CALIBRATION CHART

Y VOLTS/CM Setting	Generator Output Voltage	CM of Deflection ±3%
10V	10V	1
1V	5V	5
0.1V	0.5V	5
0.01V	5 mV	5

4-5. CHECKING SWEEP CALIBRATION

1. Connect a Fairchild Type 781 Time-Mark Generator to the Y INPUT connector of the oscilloscope through a properly terminated cable.
2. Set EXPANDER X VERNIER switch to CAL X1.
3. Sweep accuracy is checked by counting the positive peaks in the centered 8-centimeter portion of the CRT scale. Make sure the PULL VARIABLE knob is pushed in and refer to the accompanying Sweep Check Calibration Chart for additional data. All measurements indicated in this chart should fall within ±2 mm of the 9-centimeter marking, (8.8 cm to 9.2 cm).

To obtain the calibrator display, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced when obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.

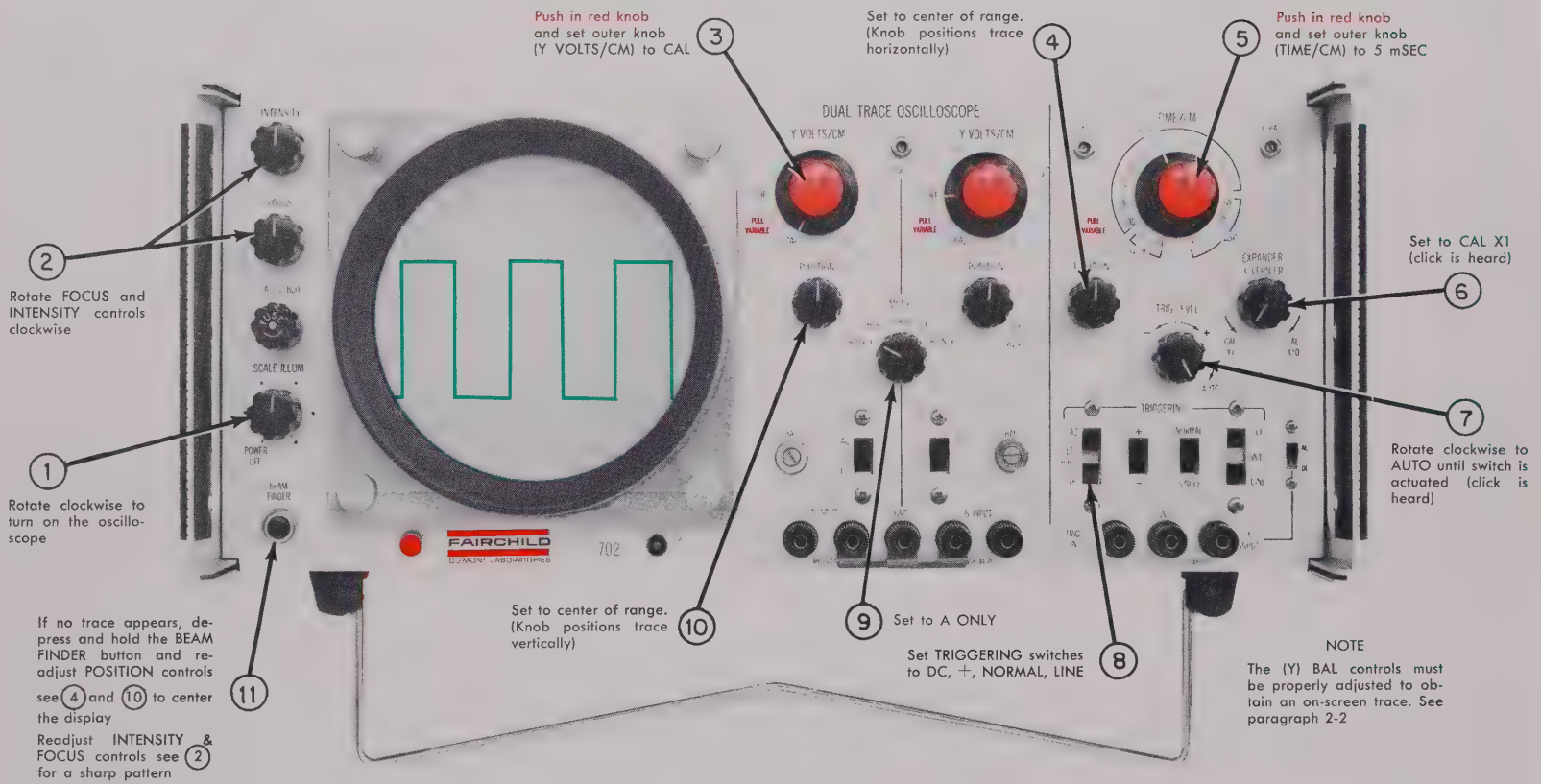

Push in red knob and set outer knob (Y VOLTS/CM) to CAL
3
Set to center of range. (Knob positions trace horizontally)
4
Push in red knob and set outer knob (TIME/CM) to 5 mSEC
5
DUAL TRACE OSCILLOSCOPE
Y VOLTS/CM
Y VOLTS/CM
TIME/CM
2
Rotate FOCUS and INTENSITY controls clockwise
SCALE ILLUM
POWER OFF
BEAM FINDER
1
Rotate clockwise to turn on the oscilloscope
FAIRCHILD
702
Set to CAL X1 (click is heard)
6
EXPANDER
TRIGGERING
7
Rotate clockwise to AUTO until switch is actuated (click is heard)
If no trace appears, depress and hold the BEAM FINDER button and readjust POSITION controls see 4 and 10 to center the display
Readjust INTENSITY & FOCUS controls see 2 for a sharp pattern
11
Set to center of range. (Knob positions trace vertically)
10
9
Set to A ONLY
Set TRIGGERING switches to DC, +, NORMAL, LINE
8
NOTE
The (Y) BAL controls must be properly adjusted to obtain an on-screen trace. See paragraph 2-2

Figure 4-1. Initial Setup of Type 702 Oscilloscope

SWEEP CHECK CALIBRATION CHART

TIME-MARK GEN set to	TIME/CM set to	NUMBER OF POSITIVE PULSES*
5 μsec marker	5 μSEC	9 timing markers
10 μsec marker	10 μSEC	9 timing markers
10 μsec marker	20 μSEC	17 timing markers
50 μsec marker	50 μSEC	9 timing markers
100 μsec marker	0.1 mSEC	9 timing markers
100 μsec marker	0.2 mSEC	17 timing markers
500 μsec marker	0.5 mSEC	9 timing markers
1 msec marker	1 mSEC	9 timing markers
1 msec marker	2 mSEC	17 timing markers
5 msec marker	5 mSEC	9 timing markers
10 msec marker	10 mSEC	9 timing markers
10 msec marker	20 mSEC	17 timing markers
50 msec marker	50 mSEC	9 timing markers
100 msec marker	100 mSEC	9 timing markers
100 msec marker	200 mSEC	17 timing markers

* Centered 8-cm portion of scale (8.8 cm to 9.2 cm)

4-6. CHECKING BANDWIDTH OF CHANNELS A & B

1. Use the test setup depicted in Figure 4-2.
2. Set Y VOLTS/CM switch to 0.01 and push in the PULL VARIABLE control.
3. Set the Hewlett-Packard Model 650A Signal Generator for 1 Kc and adjust the generator for 10 cm of vertical deflection on the screen of the oscilloscope.
4. Note the reading on the VTVM.
5. Switch the test frequency to 500 Kc and adjust output of the generator to give the same reading on the VTVM as noted in step 4. The vertical deflection amplitude observed on the screen of the oscilloscope should not be less than 7 cm.

4-7. CHECKING RISE TIME OF CHANNELS A & B

1. Preset front-panel controls as follows:

Control	Setting
Y VOLTS/CM	0.01
TIME/CM	10 μSEC
PULL VARIABLE	Both knobs pushed in
EXPANDER X VERNIER	CAL X10

2. Apply the output from a Fairchild Type 791 Square Wave Generator properly terminated to Y INPUT.
3. Set generator for 100 Kc and adjust its output for 10 cm of vertical deflection on the screen of the oscilloscope.
4. Measure the rise time. It should be from 0.7 μsec to 0.8 μsec.

4-8. CHECKING BANDWIDTH OF X AMPLIFIER

1. Use the test setup depicted in Figure 4-2 except that the X INPUT is connected directly to the 600-ohm load instead of the 6-ohm load.

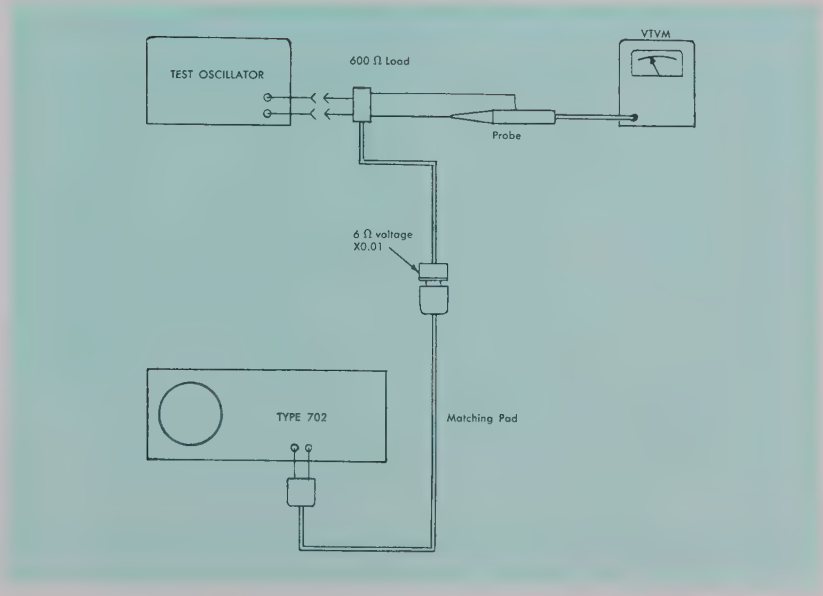


Figure 4-2. Test Setup for Bandwidth Measurement

2. Preset front-panel controls as follows:

Control	Setting
Y VOLTS/CM	OFF
TIME/CM	X V/CM 1
EXPANDER X VERNIER	CAL X1

3. Set the Hewlett-Packard Model 650A Signal Generator for 1 Kc and adjust the generator for 10 centimeters of horizontal deflection on the screen of the oscilloscope.

4. Note the reading on the VTVM.

5. Switch the test frequency to 350 Kc and adjust output of the generator to give the same reading as the VTVM as noted in step 4. The horizontal deflection amplitude observed on the screen of the oscilloscope should not be less than 7 cm.

4-9. CHECKING MODE SWITCH

1. On A ONLY, check that Channel A POSITION potentiometer controls the display.

2. On CHOP, check that Channel A and Channel B POSITION potentiometers control their respective displays.

3. On A + B, check that either Channel A or Channel B POSITION potentiometer controls the display.

4. On ALT, check that Channel A and Channel B potentiometers control their respective displays. Vary the sweep rate from high to low sweep speeds.

5. On B ONLY, check that Channel B POSITION potentiometer controls the display.

SECTION 5
MAINTENANCE AND RECALIBRATION

5-1. INTRODUCTION (Figure 5-1)

This section of the Instruction Manual contains service information and procedures for internal adjustments. Refer to Figure 5-1 for an over-all functional block diagram of the Type 702 system.

WARNING

WHEN THE PANELS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially dangerous than the cathode-ray tube potential because of the high-current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

To gain access to the chassis for service, remove the top and bottom panels. This will expose all of the transistors, tubes and service adjustments for normal maintenance.

5-2. REMOVAL AND REPLACEMENT OF PARTS

If it is necessary to order a replacement component from the factory, always give the Type Number and Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them

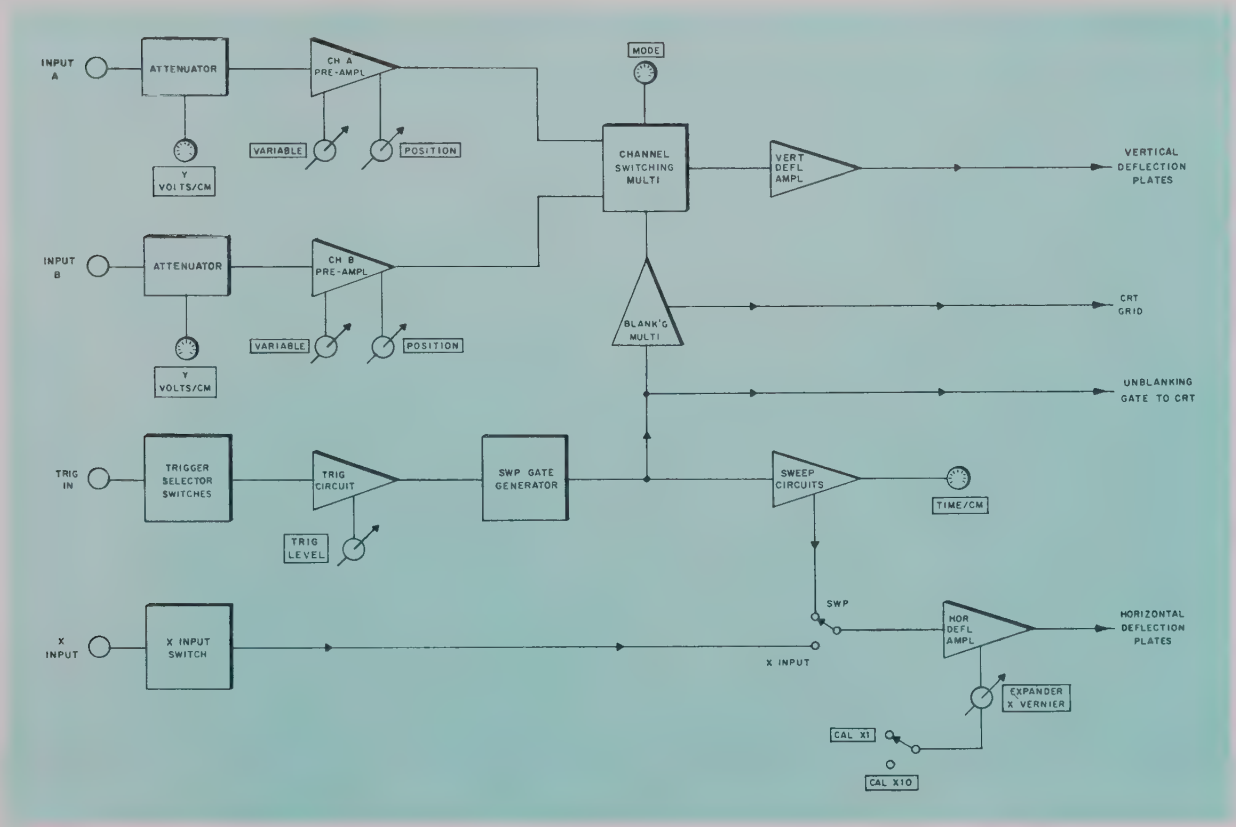


Figure 5-1. Type 702 Over-all System Block Diagram

for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings, and the factory part number for all electrical components used in the instrument. This will help to expedite service.

Since your instrument left the factory, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from the factory and it has been superseded by an improved component, the new part will be shipped in place of the part ordered.

It is the aim of the Fairchild organization to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any of our equipment to its specified performance. Your local Field representative maintains a limited number of spare parts. Also, the factory may be asked to airship replacement parts on a rush basis.

The procedure for replacing most parts in this instrument is obvious, therefore specific instructions for their removal are not required.

NOTE: Be sure and replace the beryllium oxide insulating washers (they serve as heat sinks) on the transistors that require them. Always grease these heat sings with Dow Corning silicon grease for optimum heat transfer.

5-3. CATHODE-RAY TUBE REPLACEMENT

CAUTION

THE CATHODE-RAY TUBE SHOULD BE HANDLED WITH GREAT CARE TO PREVENT BREAKAGE AND/OR SERIOUS PERSONAL INJURY FROM FLYING GLASS.

To remove the cathode-ray tube, first remove the top and rear covers. Remove the bezel, disconnect CRT socket, and loosen the tube clamp at the base of the CRT. Pull the cathode-ray tube straight out through the front panel. Install the new cathode-ray tube by the reverse of the foregoing procedure. Refer to paragraph 5-7 for CRT internal or external graticule adjustment.

After the cathode-ray tube has been replaced, it may be necessary to recalibrate. Special attention should be given to recalibration of the time base sweep rates and to the amplifier sensitivities.

5-4. SERVICING HINTS

Although this is a complex electronic instrument, trouble may be localized to the following basic circuits:

1. Low-voltage Power Supply
2. High-voltage Power Supply
3. Cathode-ray Tube Circuit
4. Vertical Deflection Amplifier
5. Trigger Circuit
6. Time Base Circuit
7. Horizontal Deflection Amplifier

Whenever trouble occurs in this instrument, first try to localize it to one of these basic circuits.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble shooting this unit, refer to the system block diagram in this Section and also to the schematics.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush. However, to insure the reliability of measurements, we suggest that you recalibrate this instrument after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be fully checked and adjusted after the repair or replacement of any component in the unit. The complete adjustment procedure for this unit is given in this Section of the Instruction Manual.

In the event of improper equipment performance, the following suggestions are recommended:

1. If the instrument fails to operate, including the pilot light, check the source of power and determine that the power cord is firmly in place; then check the fuse(s). A thermal cutout switch is incorporated in this unit. If the instrument has been working but has just stopped, it may have overheated and tripped the thermal cutout switch. The thermal cutout switch will reset itself when the interior temperature of the instrument drops to a safe value. Possible causes of overheating are restriction of air circulation and high ambient temperature.

2. If the line voltage is within the specified limits, and one of the regulated power supply output voltages is not correct, check that particular regulator circuit.

Note: Always check the power supplies in the following order: +160V, +59V, −50V and −2400V

3. If there is nothing on the screen, try to set up the oscilloscope as depicted in Figure 2-5 entitled "Initial Setup of Type 702 Oscilloscope" in Section 2 of this manual.

4. Localizing the trouble is made easier by use of a Test Oscilloscope to check waveforms. These waveforms are shown at key points on the over-all schematics. Both the waveform amplitude and time duration are given. Use a high-impedance 10:1 Passive Attenuator Probe while trouble shooting.

5. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints

smooth and bright; do not overheat any component while soldering. Use heat sinks while soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended.

6. When using the accessory probes or adapters, be sure the trouble is *not* originating in the accessory before suspecting the oscilloscope itself.

7. Once the defective stage has been localized, the component or components causing the trouble can be located by tube and component substitution or by voltage measurements. Key voltage measurements are shown on the over-all schematics at the rear of this manual.

8. Electron tubes, semiconductors, and service adjustments are identified on photographs located in this Section of the Instruction Manual.

5-5. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. Introduction

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory.

Normally only periodic adjustment of the CAL and BALance controls will be necessary. The procedure outlined in this manual should be followed. The attenuators are factory aligned and should not be touched unless there is a positive indication that they require adjustment. All adjustments should be made at mid-line voltage, 115V/230V ±2%.

b. Test Equipment Required (Equivalent may be substituted)

Equipment	Description
Volt-ohmmeter	— Simpson Model 260 or Tripplet Model 630 20,000 ohms/volt sensitivity
Square Wave Generator	— Fairchild Type 791
Time-Mark Generator	— Fairchild Type 781
Standard Amplitude Calibrator	— Ballantine Type 420
High Voltage Meter	— Sensitive Research Model DCH-1
Signal Generator	— Hewlett-Packard Type 650A with 600-ohm termination
Autotransformer	— Powerstat, Variac; capable of varying line voltage of the instrument being calibrated
AC Voltmeter	— Weston Model 433
Alignment Tools	— Fairchild Type 7013 Tool Kit
2592-B	— Shielded adapter connector; scope binding post to BNC
4285A	— 50-ohm, 5-watt termination
4290	— 10:1 Passive Attenuator Probe
7012	— Input Capacitance Standardizer (44 pf)
7082	— 42-inch coaxial jumper cable with BNC connectors at either end
7083	— 42-inch coaxial jumper cable with BNC connector at one end and alligator clip at the other end

5-6. ADJUSTING THE LOW AND HIGH VOLTAGE POWER SUPPLIES

Connect the autotransformer to a suitable power source and connect the oscilloscope output to this transformer. Turn on the instrument and set the output for the nominal operating voltage of the oscilloscope using the Weston Model 433 AC Voltmeter (115V for 115-volt operation, or 230V for 230-volt operation). Allow 30 to 60 minutes of warmup time before making any adjustments. Preset the front-panel controls as indicated.

Control	Setting
Y VOLTS/CM	CAL
TIME/CM	5 mSEC
TRIG LEVEL	AUTO
EXPANDER X VERNIER	CAL X1
TRIGGERING	AC, +, NORMAL, INT
PULL VARIABLE	Both knobs pushed in

Use a voltmeter and adjust or check the supplies in the sequence listed.

1. Set the +59V ADJ (R4008F) to center of its range.
2. Adjust R4008R for +160 volts.
3. Adjust R4008F for +59 volts.
4. Check −50V supply; (49.2V to 50.8V)
5. If the −50V supply is more negative than −50.8 volts, connect R4016 to +59V supply (white-red lead).
6. If the −50V supply is less negative than −49.2 volts, connect R4016 to −50V supply (white lead). In each case readjust R4008R (+160V ADJ).
7. Adjust HV ADJ potentiometer R4505. Use *care* and *safety leads* while making this adjustment.

CAUTION

Always use insulated tools while working or making adjustments on the unit when power is on. The transistors in the oscilloscope may be damaged if over-voltaged by accidental grounding of one or more elements. Exercise caution and turn off power when making repairs.

5-7. CRT ADJUSTMENTS

a. Astigmatism R4523

1. Set up the oscilloscope for normal operation using the calibrator signal.
2. Adjust ASTIG potentiometer R4523, simultaneously with the FOCUS control until optimized focusing of the pattern is obtained in both the horizontal and vertical plane.
3. Maintain normal intensity while making these adjustments.

b. Graticule External to CRT

To align the trace to the graticule, proceed as follows:

1. Use AUTOmatic sweep with no signal applied to the vertical channel.
2. Loosen CRT clamp.
3. Center the trace and rotate CRT so that the trace is parallel to the center line of the graticule.
4. Tighten CRT clamp.

c. Graticule Internal to CRT R4523R

1. Where the graticule is internal to the CRT, align the tube so that the horizontal center line is perpendicular to the left side of the frame. Clamp the CRT.
2. Set up instrument for automatic sweep with no signal applied to the vertical channel.
3. Adjust R4523R (concentric control as part of the ASTIG assembly) until the trace is parallel to the center line of the graticule.

5-8. X R2029 AND Y R1325 OUTPUT LEVEL ADJUSTMENTS

The X and Y OUTPUT LEVEL ADJ potentiometers are provided to set the X deflection plate average potential equal to the Y deflection plate average potential.

1. Set TIME/CM switch to X V/CM 1; adjust for a dim spot and position it to screen center.
2. Temporarily short the collectors of Q2005 and Q2006 together (located in the X amplifier).
3. Connect the voltmeter between the now common collectors to ground.
4. Adjust the X OUTPUT LEVEL ADJ potentiometer R2029 for 115 volts. A range of 116V to 120V may be permitted to eliminate on-screen amplifier cutoff.
5. Disconnect the meter and the X deflection plate short.
6. Temporarily short the collectors of Q1303 and Q1304 together (located in the Y amplifier).
7. Repeat steps 3, 4, and 5 except adjust Y OUTPUT LEVEL ADJ potentiometer R1325 for 119 volts. A range of 117V to 121V may be permitted to eliminate on-screen amplifier cutoff.

5-9. CHANNELS A & B DC BALANCE ADJUSTMENTS R1115 (R1215)

When the BAL control is properly adjusted, there will be no depositioning of the trace when the PULL VARIABLE control is used. To adjust, proceed as follows:

1. Set MODE switch to A ONLY.
2. Set Y VOLTS/CM switch to OFF and pull out the VARIABLE control knob and turn it fully counterclockwise.
3. Center the trace with the POSITION controls. If necessary, use the BEAM FINDER push button to speedily locate the display.
4. Rotate Y PULL VARIABLE control fully clockwise.
5. Adjust the BAL control to recenter the trace.
6. Repeat this procedure until there is no depositioning of the trace while rocking the VARIABLE control back and forth.
7. Set MODE switch to B ONLY and repeat steps 2 through 6.

5-10. CHANNELS A & B POSITION BALANCE ADJUSTMENTS R1128 (R1225)

NOTE

Reference symbols in parenthesis refer to Channel B.

The POSITION BAL potentiometers are provided to insure that the trace is centered when the POSITION knob is set to its mechanical center.

1. Set MODE switch to A ONLY.
2. Temporarily short together the grids of V1102A and V1102B (pins 2 and 7).
3. Adjust the POSITION BAL potentiometer R1128 until Channel A trace is centered on the screen.
4. Disconnect the jumper short from V1102.
5. Set MODE switch to B ONLY.
6. Temporarily short together the grids of V1103A and V1103B (pins 2 and 7).
7. Adjust the POSITION BAL potentiometer R1225 until Channel B trace is centered on the screen.
8. Disconnect the jumper short from V1103.
9. Set MODE switch to ALT and adjust sweep rate for 2 msec/cm.
10. Position the traces one on top of the other.
11. Adjust CAL BAL potentiometer R1125 until only one trace may be observed (traces are superimposed). The gain between channels has now been normalized.

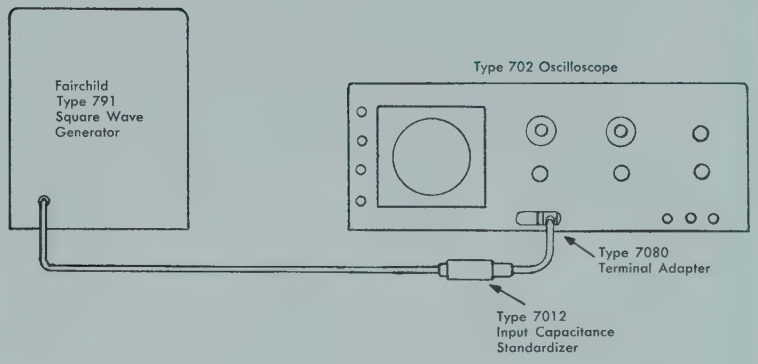


Figure 5-2a.

Test Setup for

Adjusting Input Capacitance

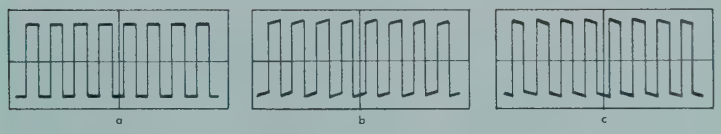
5-11. NORMALIZING Y AMPLIFIER SENSITIVITY AND CERTIFYING THE CALIBRATOR R1308 & R1125

To properly normalize the gain between channels and to calibrate the over-all Y sensitivity, proceed as follows:

1. Set Channel A Y VOLTS/CM switches to 0.01 and push in both PULL VARIABLE knobs (calibrated position).
2. Set MODE switch to B ONLY.
3. Apply a 50 millivolt peak-to-peak signal from the Ballantine Type 420 Calibrator to B INPUT.
4. Adjust the sweep controls for a stable display.
5. Adjust the Y CAL front-panel screwdriver control for precisely 5 cm of vertical deflection. The vertical deflection system is now normalized to the external standard.
6. Set Channel A Y VOLTS/CM switch to CAL. The internal calibrator signal should be displayed on the screen with an amplitude of 4.7 cm to 5.3 cm (5 cm nominally). If these limits are not met, certify the Ballantine Calibrator to a primary standard.
7. Set Channel B Y VOLTS/CM switch to CAL.

5-12. CHANNELS A & B INPUT CAPACITANCE ADJUSTMENT C1106 (C1206) (Figures 5-2a & 5-2b)

1. Set Channel A Y VOLTS/CM switch to 0.01 and Input Coupling switch to DC.
2. Set MODE switch to A ONLY.
3. Connect the output of a properly terminated square wave generator through the Type 7012 Input Capacitance Standardizer, that has been preset to 44 pf, to A INPUT. See Figure 5-2a.
4. Set square wave generator to 100 Kc and adjust the Type 7012 for best square wave response. See Figure 5-2b.
5. Adjust capacitor C1106 for best square wave response.



a: Proper adjustment
b, c: Improper adjustments

Figure 5-2b.

Standardizing the

Input Capacitance

6. Set MODE switch to B ONLY and repeat above procedure for Channel B using trimmer C1206.

5-13. CHANNELS A & B ATTENUATOR ALIGNMENT C1103 (C1203)

The attenuators are factory aligned and should not be touched unless there is positive indication that they require adjustment. If adjustment is necessary, follow the steps as outlined.

1. Set Channel A Y VOLTS/CM switch to 0.1 and MODE switch to A ONLY.
2. Connect the square wave generator set for 2.5 Kc to A INPUT.
3. Adjust C1102 for best flat top.
4. Set Y VOLTS/CM switch to 1 and check for flat top.
5. Set MODE switch to B ONLY and repeat steps 1 through 4 for Channel B using trimmer C1203.

NOTE: A tabulation check of all ranges of the attenuator is shown in the *Amplitude Check Calibration Chart* located in Section 4 of this manual.

5-14. OUTPUT PEAKING COMPENSATION TRIMMER C1304

To properly adjust the output peaking compensation trimmer, proceed as follows:

1. Preset front-panel controls as indicated:

Control	Setting
CH A Y VOLTS/CM	0.01
MODE	A ONLY
TIME/CM	20 μsec
TRIG LEVEL	AUTO
TRIGGERING	AC, +, NORMAL & INT

2. Apply the 25 Kc output of a square wave generator to A INPUT connector.
3. Start the adjustment with capacitor C1301 set fully clockwise (maximum capacity).
4. Adjust trimmer C1304 counterclockwise to a point where overpeaking is eliminated and some rounding of the square wave is visible.

5-15. X ATTENUATOR ALIGNMENT C2002

To properly align the X attenuator, proceed as follows:

1. Set TIME/CM switch to X V/CM 10, Y VOLTS/CM switch to 0.1 and MODE switch to A ONLY.
2. Temporarily ground the cathode of the sweep gate multivibrator V3501-8. This point is available on the last deck of the TIME/CM switch (yellow lead).
3. Couple the internal sawtooth signal from pin 3 of V3502 to the A INPUT connector.
4. Set up the oscilloscope for external triggering and connect the output from a square wave generator to the X INPUT connector through a Type 4285 50-ohm termination and a Type 2592-B Terminal Adapter.
5. Set square wave generator for 10 Kc and adjust C2002 for best flat top.
6. Remove temporary ground set up in step 2.

5-16. X BALANCE ADJUSTMENT R2021

When this front-panel screwdriver control is properly adjusted, the display on screen will expand equally about screen center for either the internal time base or externally applied signals. To adjust, proceed as follows:

1. Preset front-panel controls as indicated:

Control	Setting
MODE	A ONLY
Y VOLTS/CM	CAL
TIME/CM	X V/CM 10
EXPANDER X VERNIER	CAL X10
TRIG LEVEL	AUTO

2. Temporarily ground the X INPUT binding post.
3. Rock the EXPANDER X VERNIER control back and forth several times while adjusting the X POSITION control to locate a point on screen where the X display appears to be balanced.
4. Adjust the front-panel screwdriver X BAL control to center the trace.
5. Repeat steps 3 and 4 until there is no depositioning of the trace as the EXPANDER X VERNIER control is rotated throughout its range.
6. Remove the temporary ground from the X INPUT binding post.

5-17. NORMALIZING X AMPLIFIER (CAL R2016, and 10:1 ADJ R2013)

The X CAL front-panel screwdriver control is employed to calibrate the X amplifier sensitivity.

To properly normalize the gain of this instrument, proceed as follows:

1. Preset front-panel controls as indicated:

Control	Setting
MODE	A ONLY
TIME/CM	5 mSEC
EXPANDER X VERNIER	CAL X10
TRIG LEVEL	AUTO
PULL VARIABLE	Both knobs pushed in
Y VOLTS/CM	0.1V

2. Connect the output from a Time-Mark Generator to the A INPUT connector of the oscilloscope through a Type 4285A 50-ohm termination and a Type 2592-B Terminal Adapter.
3. Set generator to 500 μSEC and adjust the front-panel screwdriver X CAL control for precisely 1 timing marker/cm.
4. Set EXPANDER X VERNIER switch to CAL X1.
5. Set generator for 5 mSEC.
6. Set 10:1 ADJ potentiometer R2013 for precisely 1 timing marker/cm.

5-18. SWEEP LENGTH ADJUSTMENT R3536

The Sweep LENGTH potentiometer is provided so that the trace may be adjusted to display a horizontal scale of 10 to 11.5 centimeters when oscilloscope is set up for calibrated unexpanded sweep.

1. Set up the oscilloscope to obtain a normal calibrator display on the screen.
2. Adjust Sweep LENGTH potentiometer R3536 until the display occupies 10.5 cm of horizontal deflection.

5-19. FAST SWEEP CALIBRATION ADJUSTMENT C2052

1. Apply a 5-microsecond time-marker signal from a Fairchild Type 781 Time-Mark Generator through a properly terminated cable to the A INPUT connector.
2. Set MODE switch to A ONLY and adjust the Y VOLTS/CM switch to give the display a vertical amplitude of about 4 centimeters.
3. Set TIME/CM switch to 5 μSEC and push in PULL VARIABLE control.
4. Using an insulated screwdriver, adjust trimmer C2052 for one pulse per centimeter.

NOTE: A tabulation check of all sweep ranges is shown in the *Sweep Check Calibration Chart* located in Section 4 of this manual.

5-20. PHASE SHIFT ADJUSTMENT C2013

A phase shift trimmer capacitor C2013 is added across the output of the horizontal deflection amplifier and is adjusted when necessary for optimum phase differential between the X and Y amplifiers in a particular application. Normally, C2013 is set to minimum and does not require recalibration since its adjustment applies only to the X-Y comparison measurement on display.

If phase shift measurement is required for certification, proceed as follows:

1. Apply a 100 Kc sine wave signal from a properly terminated generator to both the INPUT A and INPUT B connectors.
2. Set Y VOLTS/CM switches to 1, TIME/CM switch to XV/CM 1, and EXPANDER/X VERNIER control to CAL X1.
3. Adjust sine wave generator for 8 centimeters of deflection.
4. Adjust C2013 for a single diagonal line (zero phase shift).

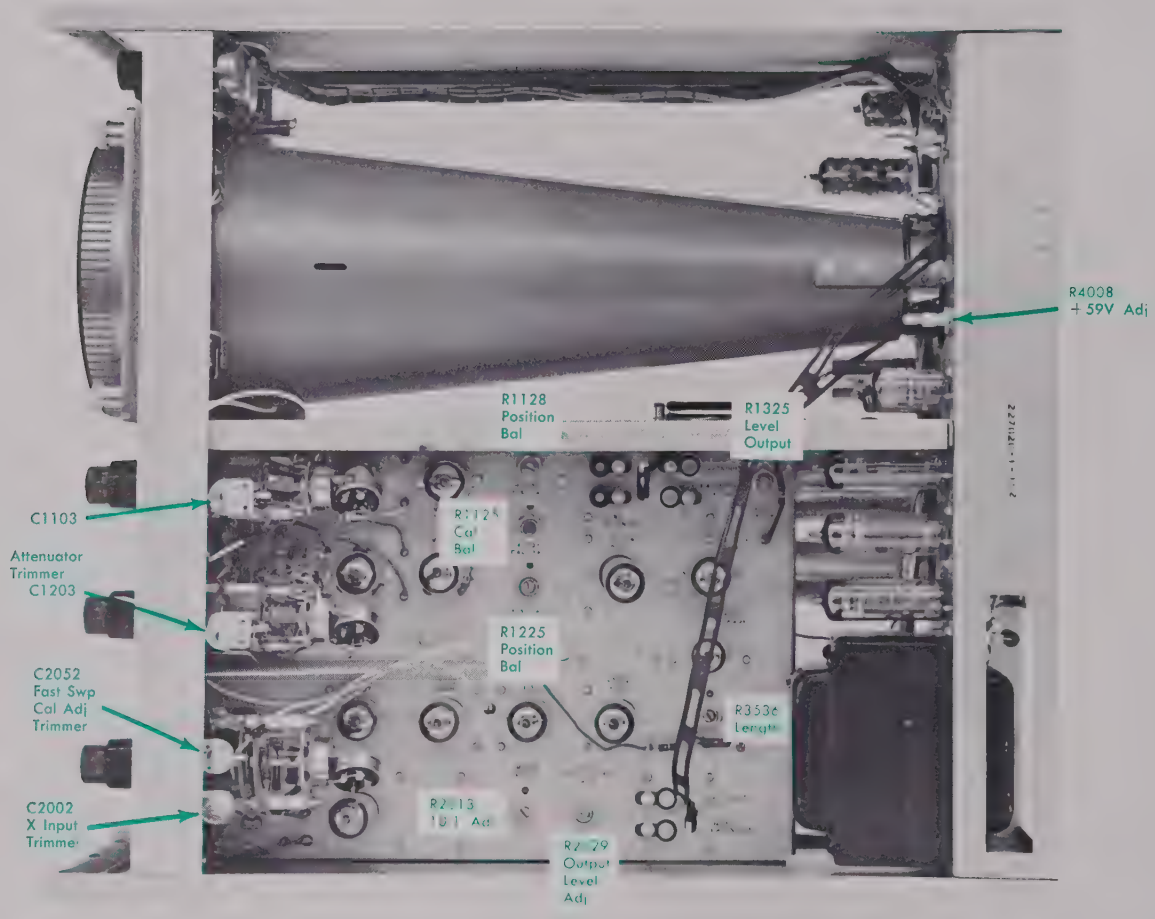


Figure 5-3a. Top View Showing Attenuator Trimmers & Pot Adjustments

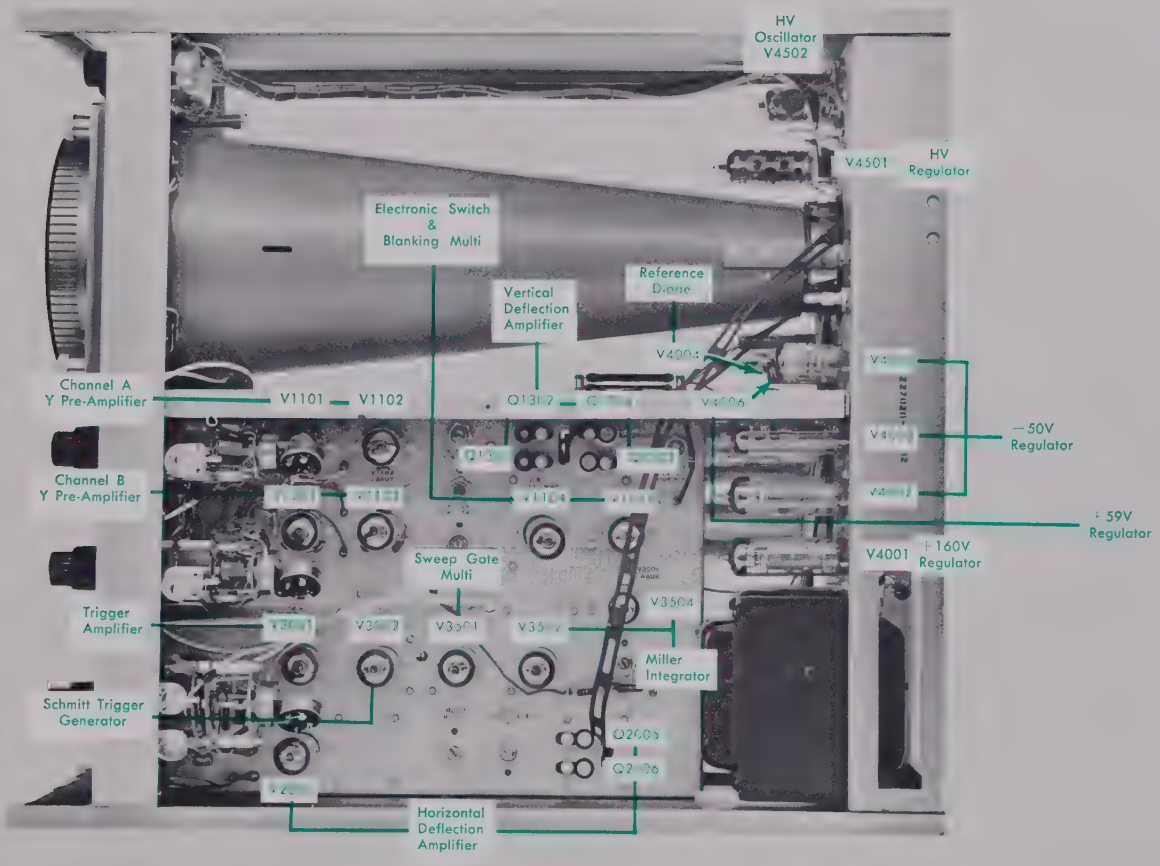


Figure 5-3b. Top View Showing Transistors & Tubes

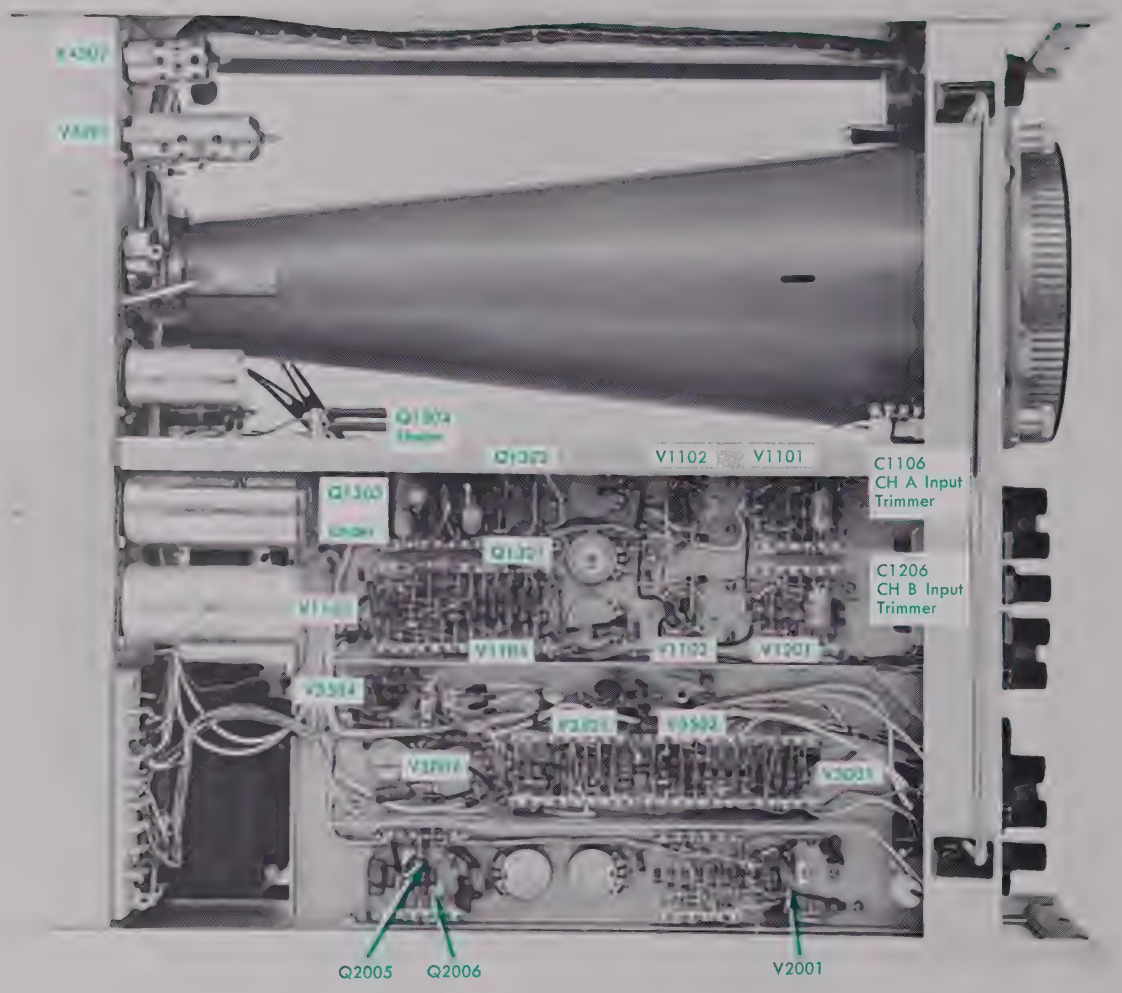


Figure 5-4. Bottom View Showing Input Trimmers, Transistors & Tube Location

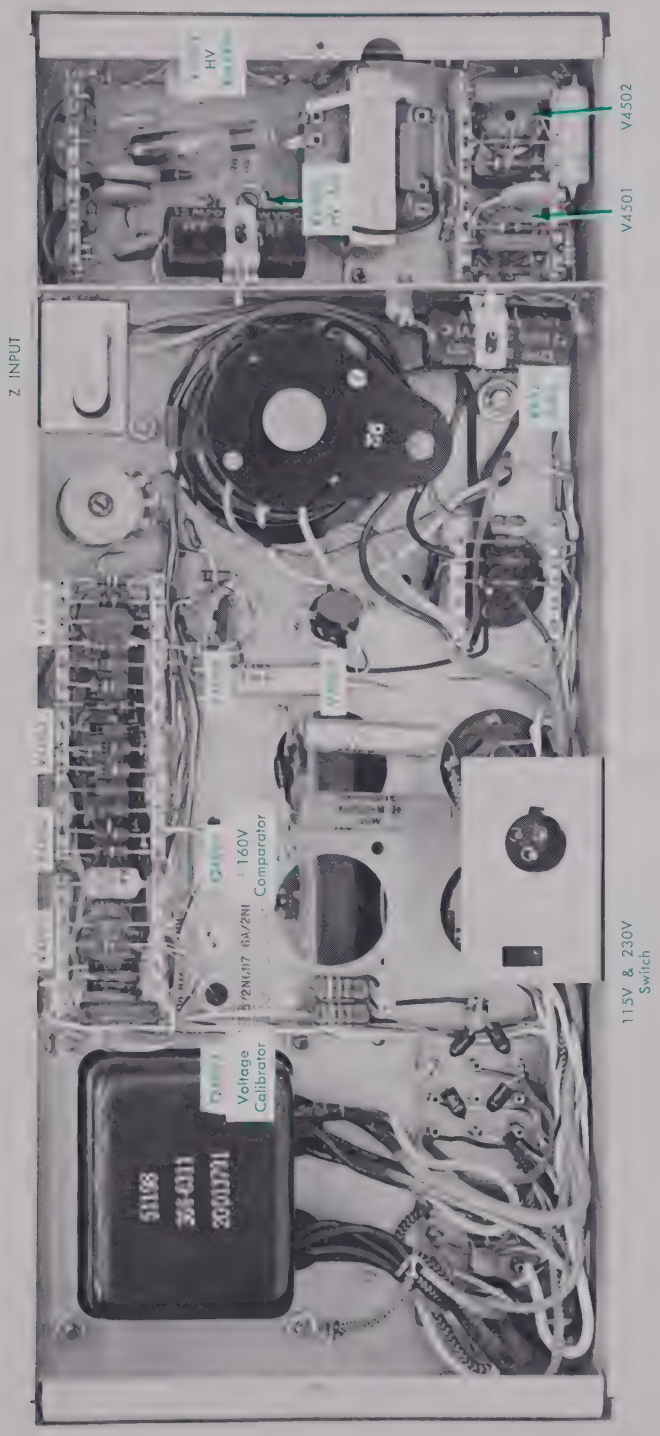


Figure 5-5. Rear View Showing Transistors, Tube Location & Pot Adjustments

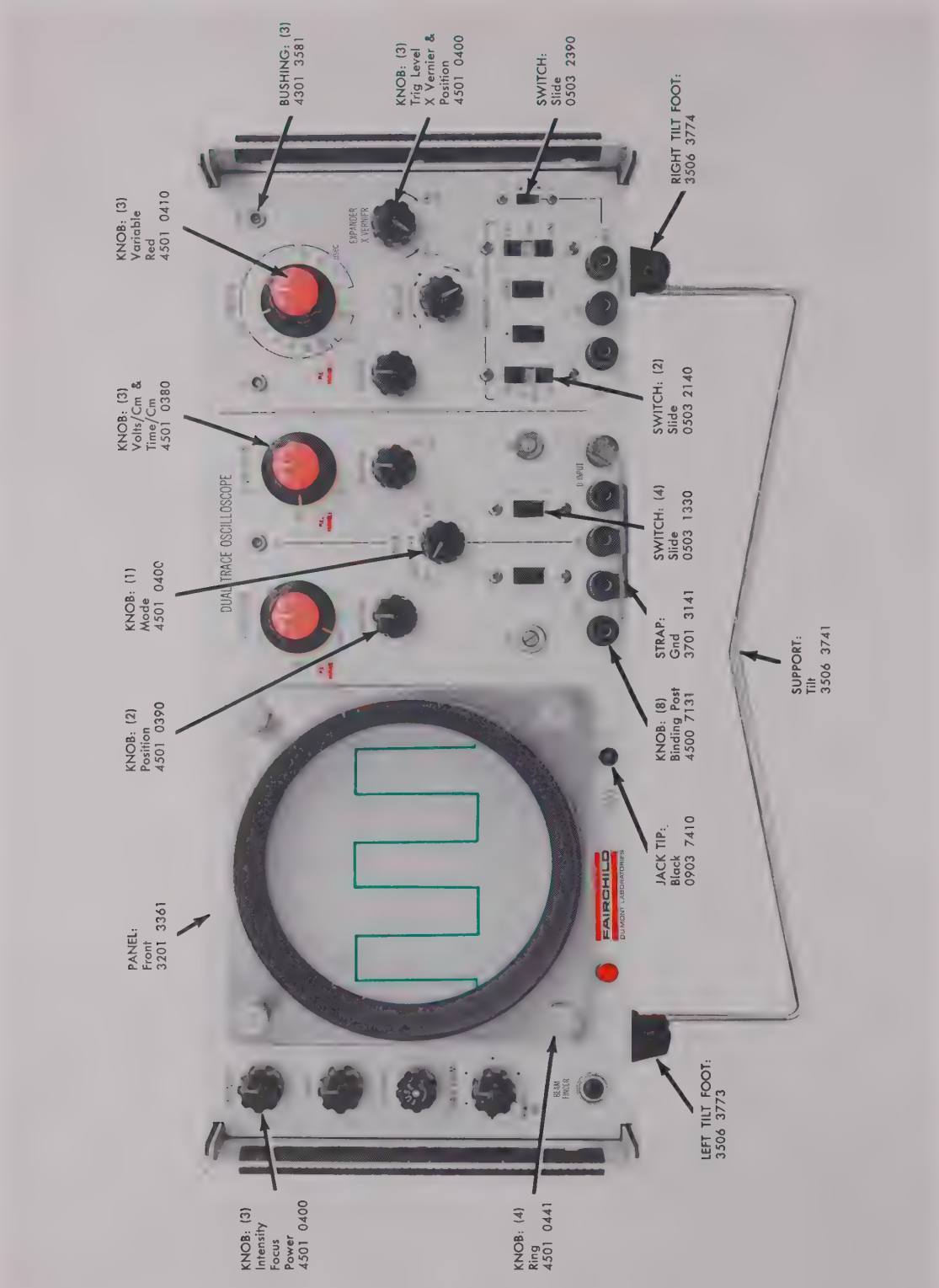


Figure 6-1. Front Panel Replaceable Parts

SECTION 6A
ELECTRICAL PARTS LIST AND SCHEMATICS

TYPE 702 OSCILLOSCOPE

CAPACITORS

Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf (μμf) denotes picofarads.

2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1102	0326 5710	plastic, 0.1 μf, ±20%, 600V	GUD	355F
C1102	0316 7560	18 pf, ±0.5 pf	ERC	TS2A
C1103	0326 8650	variable, 4-30 pf	ERC	TS2A
C1104	0305 5740	mica, 180 pf, ±10%	EIA	
C1105	0313 6120	mica, 160 pf, ±2%	EMC	605
C1106	0319 1263	variable, plastic, 0.65-3.2 pf, 300V	ABD	
C1107	0326 4640	0.01 μf, GMV	ERC	811
C1108	0326 7860	plastic, 0.1 μf, ±10%, 125V	AMX	C296AB
C1109	0326 4640	0.01 μf, GMV	ERC	811
C1110	0316 7360	13 pf, ±5%	ERC	NPO-331
C1111 & C1112	0316 7110	2.2 pf, ±0.25 pf	ERC	NPO-331
C1113	0316 7220	5.6 pf	ERC	NPO-331
C1201	0326 5710	plastic, 0.1 μf, ±20%, 600V	GUD	355F
C1202	0316 7560	18 pf, ±0.5 pf	CRL	TCZ
C1203	0326 8650	variable, 4-30 pf	ERC	TS2A
C1204	0305 5740	mica, 180 pf, ±10%	EIA	
C1205	0313 6120	mica, 160 pf, ±2%	EMCq	605
C1206	0319 1263	variable, plastic, 0.65-3.2 pf, 300V	ABD	
C1207	0326 4640	0.01 μf, GMV	ERC	811
C1208	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C1209	0326 4640	0.01 μf, GMV	ERC	811
C1210	0316 7360	13 pf, ±5%	ERC	NPO-331
C1211 & C1212	0316 7110	2.2 pf, ±0.25 pf	ERC	NPO-331
C1213	0316 7220	5.6 pf	ERC	NPO-331
C1301	0317 6700	mica, 620 pf, ±5%	EMC	DM20
C1302 & C1303	0316 7230	6.2 pf, ±0.25 pf	ERC	NPO-331
C1304	0327 2990	variable, mica, 24-200 pf, 350V	ELM	42 Part #425
C1305	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C1306	0326 4640	0.01 μf, GMV	ERC	811
C1308	0316 7250	7.5 pf, ±0.25 pf	ERC	NPO-331
C1309	0315 6990	10 pf, ±1 pf, 1000V	RMC	C
C1401 & C1402	0319 5850	27 pf, ±5%	ERC	NPO-332
C1403	0316 7470	47 pf, ±5%	ERC	
C1404	0319 5850	27 pf, ±5%	ERC	NPO-332
C1405	0326 8060	plastic, 0.1 μf, ±10%, 400V	AMX	C296AC
C1406	0317 5330	mica, 160 pf, ±5%	EMC	DM15
C1407	0315 2970	39 pf, ±10%	ERC	GPSL 331
C1408	0326 4640	0.01 μf, GMV	ERC	811
C2001	0326 5710	plastic, 0.1 μf, ±10%, 600V	GUD	355F
C2002	0317 5340	mica, 180 pf, ±5%	EMC	DM15
C2003	0326 4640	0.01 μf, GMV	ERC	811
C2004	0316 7110	2.2 pf, ±0.25 pf	ERC	NPO-331
C2005 & C2006	0316 7220	5.6 pf, ±0.25 pf	ERC	NPO-331
C2007	0317 6730	mica, 820 pf	EMC	DM20
C2008	0317 5090	mica, 18 pf, ±5%	EMC	DM15
C2009	0326 4640	0.01 μf, GMV	ERC	811
C2010 & C2011	0326 9490	variable, 2-8 pf, 200V	ERC	538
C2012	0317 5400	mica, 300 pf, ±5%	EMC	DM15
C2013	0319 1450	variable, 3-12 pf, ±5%	ERC	NPO-503
C2051	0319 9410	62 pf, ±5%	ERC	331
C2052	0326 8650	variable, 4-30 pf	ERC	TS2A
C2053	0327 2000	plastic, 0.086 μf, ±1%, 100V	GUD	336B
C2054	0318 5370	mica, 8514 pf, ±1%	EMC	
C2055	0319 9830	plastic, 0.0047 μf, ±20%, 400V	GUD	355E
C2056	0326 7840	plastic, 0.047 μf, ±10%, 200V	AMX	C296AB
C3001	0326 4520	1000 pf, GMV	ERC	831
C3002	0326 4550	2000 pf, GMV	ERC	831
C3003	0315 2000	100 pf, ±20%	EIA	
C3004	0326 4640	0.01 μf, GMV	ERC	811
C3005	0319 5850	27 pf, ±5%	ERC	NPO-332
C3006	0326 4640	0.01 μf, GMV	ERC	811
C3007	0326 7840	plastic, 0.047 μf, ±10%, 200V	AMX	C296AB
C3008	0315 2970	39 pf, ±10%	ERC	GPSL-331
C3009	0316 7470	47 pf, ±5%	ERC	NPO-331
C3506	0326 8060	plastic, 0.1 μf, ±10%, 400V	AMX	C296AC
C3507	0316 6630	390 pf, ±10%	ERC	GP2-331
C3508	0326 4640	0.01 μf, GMV	ERC	811
C3509	0316 7360	13 pf, ±5%	ERC	NPO-331
C3511	0326 4640	0.01 μf, GMV	ERC	811
C3512 & C3513	0305 5100	mica, 51 pf, ±5%	EIA	
C3514	0326 8060	plastic, 0.1 μf, ±10%, 400V	AMX	C296AC
C4000	0326 4640	0.01 μf, GMV	ERC	811
C4001	0327 1940	electrolytic, 100 μf, +100 −10%, 400V	MAL	FP
C4002	0326 4640	0.01 μf, GMV	ERC	811
C4003	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C4004	0300 2440	electrolytic, 10 μf, +50 −10%, 450V	CDE	UP-1045
C4005	0319 4460	electrolytic, 150 μf, +100 −10%, 300V	MAL	FP
C4006	0326 7590	electrolytic, 12 μf, +100 −10%, 150V	SPG	30D219A1
C4008	0326 4640	0.01 μf, GMV	ERC	811
C4010	0326 4640	0.01 μf, GMV	ERC	811
C4012 & C4013	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C4014	0326 7590	electrolytic, 12 μf, +100 −10%, 150V	SPG	30D219A1
C4016	0326 4640	0.01 μf, GMV	ERC	811
C4501	0327 1910	3300 pf, +80 −20%, 4000V	CRL	CJ
C4502	0316 9190	paper, 1000 pf, ±20%, 3000V	RMC	3 KV
C4503 & C4504	0326 4640	0.01 μf, GMV	ERC	811
C4505	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C4506	0327 1910	3300 pf, +80 −20%, 4000V	CRL	CJ
C4507 & C4508	0326 4640	0.01 μf, GMV	ERC	811
C4509	0312 9300	mica, 1000 pf, ±5%	EMC	603M
C4510	0326 8060	plastic, 0.1 μf, ±10%, 400V	AMX	C296AC
C4511	0316 8790	mica, 510 pf, ±20%, 1000V	EMC	VCM-20-B
C4513	0326 4640	0.01 μf, GMV	ERC	811
C4514 & C4515	0317 2920	electrolytic, 12 μf, +100 −0%, 350V	CDE	BR1235
C4516 & C4517	0327 1910	3300 pf, +80 −20%, 4000V	CRL	CJ
C4518	0326 4660	0.02 μf, GMV	ERC	841

Symbol	Part Number	Description	Recommended Vendor Code	Type
SEMICONDUCTORS				
CR1401 to CR1404	2600 6910	diode, FD841	FCI	
CR3501 to CR3506	2600 6910	diode, FD841	FCI	
CR3507	2600 6820	diode, FD281	FCI	
CR3508	2600 8020	diode, FDG3091	FCI	
CR4001 to CR4006	2600 9220	diode, silicon 1N4384	GEN	
CR4501	2600 3031	rectifier, metallic	ABD	
LAMPS				
DS4001	1201 1280	incandescent, 6.3V, GE #12	GE	#12
DS4002 & DS4003	1200 1310	incandescent, bayonet, 6.3V, #47	GE	#47
E3501	1200 3960	glow, NE-2	GE	NE-2
FUSE				
F410	1100 0990	2 amperes, slow blow (115V)	LFI	313002
ELECTRICAL CONNECTORS				
J1001 & J1002	5101 2551	binding post (A INPUT)	ABD	
J1003 & J1004	5101 2551	binding post (B INPUT)	ABD	
J1005	5101 2553	binding post (GND)	ABD	
J2001	5101 2551	binding post (EXT INPUT)	ABD	
J3001	5101 2551	binding post (EXT TRIG)	ABD	
J3002	5101 2553	binding post (EXT TRIG GND)	ABD	
J4001	0903 7410	jack tip, black (CAL 0.5V p-p)	UCN	No. 118930
J4002	0904 4234	receptacle, ac, modified	ABD	
TRANSISTORS				
Q1301	2600 7080	DU #2B	FCI	
& Q1302	2600 7050	alternate, 2N915		
Q1303	2600 7270	DU #6A	FCI	
& Q1304	2600 7250	alternate, 2N1893		
Q2005	2600 7270	DU #6A	FCI	
& Q2006	2600 7250	alternate, 2N1893		
Q4001	2600 7210	DU #5	FCI	
	2600 7250	alternate, 2N1893		
Q4007	2600 7210	DU #5	FCI	
	2600 7200	alternate, 2N697		
RESISTORS				

Note: All resistors are fixed, film, ±5%, ½W, and values are in ohms unless otherwise specified. K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1101	0229 4700	1M, ±1%	TEX	CD1/2PR
R1102	0204 1440	composition, 10M	IRC	GBT1/2
R1103	0236 8960	111K, ±1%	CGW	N20
R1104	0236 5680	1K, ±1%	CGW	N20
R1105	0236 8950	10.1K, ±1%	CGW	N20
R1106	0203 2010	composition, 100K, ±10%	ALB	EB
R1107 & R1108	0203 1770	composition, 1K, ±10%	ALB	EB
R1109	0229 4990	1M, ±1%	ELC	DC1/2B
R1110	0203 2010	composition, 100K, ±10%	ALB	EB
R1111	0203 1650	composition, 100, ±10%	ALB	EB
R1112	0203 0330	composition, 240	ALB	EB
R1113 & R1114	0203 0820	composition, 27K	ALB	EB
R1115	0109 2100	variable, composition, 500, ±20% (DC BAL)	CTS	VA45
R1116	0203 0970	composition, 110K	ALB	EB
R1117 (part of S111)	0107 2772	variable, composition, 10K, ±20% (VARIABLE)	ABD	
R1118	0203 0470	composition, 910	ALB	EB
R1119	0107 2861	variable, composition, 1K (POSITION)	ABD	
R1120	0203 1030	composition, 200K	ALB	EB
R1121	0203 1050	composition, 240K	ALB	EB
R1122 & R1123	0203 1650	composition, 100, ±10%	ALB	EB
R1124	0236 6290	4.32K, ±1%	CGW	NS20
R1125	0109 1310	variable, composition, 1.5K, ±20% (CAL BAL)	CTS	45
R1126	0203 0330	composition, 240	ALB	EB
R1127	0236 6290	4.32K, ±1%	CGW	NS20
R1128	0108 4620	composition, 500, ±20%, 1W (POS BAL)	CTS	90CV
R1201	0229 4700	1M, ±1%	TEX	CD1/2PR
R1202	0204 1440	composition, 10M	ALB	GBT
R1203	0236 8960	111K, ±1%	CGW	N20
R1204	0236 5680	1K, ±1%	CGW	N20
R1205	0236 8950	10.1K, ±1%	CGW	N20
R1206	0203 2010	composition, 100K, ±10%	ALB	EB
R1207 & R1208	0203 1770	composition, 1K, ±10%	ALB	EB
R1209	0229 4990	1M, ±1%	ELC	DC1/2B
R1210	0203 2010	composition, 100K, ±10%	ALB	EB
R1211	0203 1650	composition, 100, ±10%	ALB	EB
R1212	0203 0330	composition, 240	ALB	EB
R1213 & R1214	0203 0820	composition, 27K	ALB	EB
R1215	0109 2100	variable, composition, 500, ±20% (DC BAL)	CTS	VA45
R1216	0203 0970	composition, 110K	ALB	EB
R1217 (part of S121)	0107 2772	variable, composition, 10K, ±20% (VARIABLE)	ABD	
R1218	0203 0470	composition, 910	ALB	EB
R1219	0107 2851	variable, composition, 1K (POSITION)	ABD	
R1220	0203 1030	composition, 200K	ALB	EB
R1221	0203 1050	composition, 240K	ALB	EB
R1222 & R1223	0203 1650	composition, 100, ±10%	ALB	EB
R1224	0203 0400	composition, 470	ALB	EB
R1225	0108 4620	variable, composition, 500, ±20%, 1W (POS BAL)	CTS	90CV
R1301	0203 0760	composition, 15K	ALB	EB
R1302	0203 0720	composition, 10K	ALB	EB
R1303	0203 0760	composition, 15K	ALB	EB
R1304 & R1305	0203 1650	composition, 100, ±10%	ALB	EB
R1306 & R1307	0203 0920	composition, 68K	ALB	EB
R1308	0109 2070	variable, composition, 500, ±20%, 0.33W (CAL ADJ)	CTS	70
R1309	0203 0330	composition, 240	ALB	EB
R1311 & R1312	0203 0600	composition, 3.3K	ALB	EB
R1313	0203 1650	composition, 100, ±10%	ALB	EB
R1314	0237 1100	13K, 2W	CGW	C42S
R1315	0203 0590	composition, 3K	ALB	EB
R1316	0203 1650	composition, 100, ±10%	ALB	EB
R1317	0203 0280	composition, 150	ALB	EB
R1319	0203 0830	composition, 30K	ALB	EB
R1321	0203 0930	composition, 75K	ALB	EB
R1322	0203 0350	composition, 300	ALB	EB
R1323 & R1324	0237 1130	18K, 2W	CGW	C42S
R1325	0108 4680	variable, composition, 5K, ±20%, 1W (LEVEL OUTPUT)	CTS	90CV
R1326 & R1327	0236 9790	7.5K, ±2%, 2W	CGW	C42S
R1328	0203 1220	composition, 1.2M	ALB	EB
R1329	0203 1050	composition, 240K	ALB	EB
R1331	0203 1130	composition, 510K	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1332	0203 1850	composition, 4.7K, ±10%	ALB	EB
R1401 & R1402	0203 0790	composition, 20K	ALB	EB
R1403	0237 1210	39K, 2W	CGW	C42S
R1404	0203 1030	composition, 200K	ALB	EB
R1405	0203 0870	composition, 43K	ALB	EB
R1406	0203 0560	composition, 2.2K	ALB	EB
R1407	0203 0870	composition, 43K	ALB	EB
R1408	0203 1030	composition, 200K	ALB	EB
R1409	0237 1210	39K, 2W	CGW	C42S
R1410	0203 0790	composition, 20K	ALB	EB
R1411	0203 1240	composition, 1.5M	ALB	EB
R1412	0203 0720	composition, 10K	ALB	EB
R1413 & R1414	0203 1000	composition, 150K	ALB	EB
R1415	0203 1690	composition, 220, ±10%	ALB	EB
R1416	0236 9890	20K, 2W	CGW	C42S
R1417	0203 1650	composition, 100, ±10%	ALB	EB
R1418	0203 0960	composition, 100K	ALB	EB
R1419	0203 1650	composition, 100, ±10%	ALB	EB
R1421 & R1422	0203 1030	composition, 200K	ALB	EB
R1423	0237 0950	3.3K, 2W	CGW	C42S
R1424	0203 0280	composition, 150	ALB	EB
R2003	0109 0040	variable, composition, 100K ±20%, 1/3W (POSITION)	CTS	45
R2004	0203 0960	composition, 100K	ALB	EB
R2005	0203 0760	composition, 15K	ALB	EB
R2006 & R2007	0203 1690	composition, 220, ±10%	ALB	EB
R2008 & R2009	0203 0830	composition, 30K	ALB	EB
R2010	0203 1040	composition, 220K	ALB	EB
R2011	0203 0460	composition, 820	ALB	EB
R2012	0107 2764	variable, composition, 30K, 1/4W (VERNIER)	ABD	
R2013	0108 4770	variable, composition, 200K, ±20%, 1W (10:1 ADJ)	CTS	90CV
R2014	0203 0830	composition, 30K	ALB	EB
R2015	0203 0580	composition, 2.7K	ALB	EB
R2016	0109 2080	variable, composition, 50K, ±20%, 0.2W (CAL ADJ)	CTS	70
R2017 & R2018	0203 0620	composition, 3.9K	ALB	EB
R2019	0203 0960	composition, 100K	ALB	EB
R2021	0109 2090	variable, composition, 100K, ±20%, 0.2W (EXP BAL)	CTS	70
R2022	0203 0960	composition, 100K	ALB	EB
R2023 & R2024	0203 1030	composition, 200K	ALB	EB
R2025 & R2026	0203 1650	composition, 100, ±10%	ALB	EB
R2027 & R2028	0234 9360	20K, 1W	CGW	C32
R2029	0108 4680	variable, composition, 5K, ±20%, 1W (OUTPUT LEVEL ADJ)	CTS	90CV
R2031	0203 1670	composition, 150, ±10%	ALB	EB
R2032	0203 0350	composition, 300	ALB	EB
R2033 & R2034	0237 1070	10K, 2W	CGW	C42S
R2035	0236 6930	20K, ±1%	CGW	NS20
R2036	0229 4680	2M, ±1%	TEX	CD1/2PR
R2037	0229 5010	1.82M, ±1%	ELC	MF7C
R2038	0236 7980	200K, ±1%	CGW	NS20
R2051 (part of S203)	0107 2771	variable, composition, 50K (VARIABLE)	ABD	
R2052	0203 0790	composition, 20K	ALB	EB
R2053 & R2054	0234 2270	10M, ±1%	TEX	CD1/2SR
R2055	0234 2260	6M, ±1%	TEX	CD1/2SR
R2056	0229 4680	2M, ±1%	TEX	CD1/2PR
R2057	0229 4990	1M, ±1%	ELC	DC1/2B
R2058	0234 2270	10M, ±1%	TEX	CD1/2SR
R2059	0229 4990	1M, ±1%	ELC	DC1/2B
R3001	0203 1890	composition, 10K, ±10%	ALB	EB
R3002	0203 0960	composition, 100K	ALB	EB
R3003	0203 1200	composition, 1M	ALB	EB
R3004	0203 1040	composition, 220K	ALB	EB
R3005	0203 1000	composition, 150K	ALB	EB
R3006 (part of S313)	0107 2741	variable, composition, 500K, 1/4W (TRIG LEVEL)	ABD	
R3007	0203 0890	composition, 51K	ALB	EB
R3008	0203 1650	composition, 100, ±10%	ALB	EB
R3009	0203 0720	composition, 10K	ALB	EB
R3010	0203 0930	composition, 75K	ALB	EB
R3011	0203 1650	composition, 100, ±10%	ALB	EB
R3012	0234 9260	7.5K, 1W	CGW	C32
R3013	0234 9470	56K, 1W	CGW	C32
R3014	0203 0690	composition, 7.5K	ALB	EB
R3015 & R3016	0234 8540	24K	CGW	C20
R3017	0234 9490	68K, 1W	CGW	C32
R3018 & R3019	0203 0880	composition, 47K	ALB	EB
R3021	0203 1650	composition, 100, ±10%	ALB	EB
R3022	0203 1270	composition, 2M	ALB	EB
R3023	0203 0540	composition, 1.8K	ALB	EB
R3024	0236 7740	140K, ±1%	CGW	N20
R3025	0236 7770	150K, ±1%	CGW	N20
R3026	0203 1650	composition, 100, ±10%	ALB	EB
R3027	0203 0600	composition, 3.3K	ALB	EB
R3028	0203 0780	composition, 18K	ALB	EB
R3512	0203 0550	composition, 2K	ALB	EB
R3513	0203 1610	composition, 47, ±10%	ALB	EB
R3516	0203 1040	composition, 220K	ALB	EB
R3518	0236 7210	39.2K, ±1%	CGW	N20
R3519	0203 1650	composition, 100, ±10%	ALB	EB
R3521	0236 7040	26.1K, ±1%	CGW	N20
R3522	0236 3090	200K	CGW	N20
R3523	0203 1000	composition, 150K	ALB	EB
R3525	0239 1408	30K, 2W	CGW	C42
R3526 & R3527	0203 0890	composition, 51K	ALB	EB
R3528	0203 0900	composition, 56K	ALB	EB
R3529	0203 0960	composition, 100K	ALB	EB
R3530	0203 0520	composition, 1.5K	ALB	EB
R3531	0203 1080	composition, 330K	ALB	EB
R3532	0203 0870	composition, 43K	ALB	EB
R3533	0203 0930	composition, 75K	ALB	EB
R3534	0203 1650	composition, 100, ±10%	ALB	EB
R3535	0239 1383	3.3K, 2W	CGW	C42
R3536	0109 1310	variable, composition, 1.5K (LENGTH)	CTS	Series 45
R3537	0239 1389	5.6K, 2W	CGW	C42
R3538	0236 7440	68.1K, ±1%	CGW	N20
R3539	0234 9440	43K, 1W	CGW	C32
R3540	0234 9280	9.1K, 1W	CGW	C32
R3541	0203 1650	composition, 100, ±10%	ALB	EB
R3542	0203 0540	composition, 1.8K	ALB	EB
R3543	0234 9420	36K, 1W	CGW	C32
R3544	0203 0770	composition, 16K	ALB	EB
R3545	0203 0870	composition, 43K	ALB	EB
R3546	0203 1440	composition, 10M	ALB	EB
R3547	0203 2130	composition, 1M, ±10%	ALB	EB
R4000	0239 1491	100K, ±10%, 2W	CGW	C42
R4001	0203 1280	composition, 2.2M	ALB	EB
R4002	0203 0820	composition, 27K	ALB	EB
R4003	0234 2670	wire wound, 270, 5W	DAL	CS5
R4004	0203 1770	composition, 1K, ±10%	ALB	EB
R4005 & R4006	0203 0070	composition, 20	ALB	EB
R4007	0234 8540	24K	CGW	C20
R4008 F,R	0109 1560	variable, wire wound, 10K/10K, ±10% (+57V/+160V ADJ)	CTS	C2-AW
R4009	0234 8620	51K	CGW	C20
R4010	0203 1770	composition, 1K, ±10%	ALB	EB
R4011	0234 9350	18K, 1W	CGW	C32
R4012	0236 9090	wire wound, 5K, 20W	TRU	MOR 20
R4013	0203 1270	composition, 2M	ALB	EB
R4014	0203 1800	composition, 1.8K, ±10%	ALB	EB
R4015	0203 1340	composition, 3.9M	ALB	EB
R4016	0203 2040	composition, 180K, ±10%	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Type
R4017	0203 1120	composition, 470K	ALB	EB
R4018	0203 0720	composition, 10K	ALB	EB
R4019	0236 7740	140K, ±1%	CGW	C20
R4021	0236 7260	44.2K, ±1%	CGW	N20
R4026	0203 1770	composition, 1K, ±10%	ALB	EB
R4029	0203 1770	composition, 1K, ±10%	ALB	EB
R4031	0203 1770	composition, 1K, ±10%	ALB	EB
R4032	0107 2344	variable, wire wound, 50, ±10%, 2W (SCALE)	ABD	
R4033	0203 1770	composition, 1K, ±10%	ALB	EB
R4034	0203 2130	composition, 1M, ±10%	ALB	EB
R4035	0234 8630	56K	CGW	C20
R4036	0234 8610	47K	CGW	C20
R4038	0203 1770	composition, 1K, ±10%	ALB	EB
R4040	0210 6100	wire wound, 1.5K, 10W	SPG	10KT
R4041	0203 1270	composition, 2M, ±10%	ALB	EB
R4043	0203 1770	composition, 1K, ±10%	ALB	EB
R4050	0203 0640	composition, 4.7K	ALB	EB
R4051	0239 1406	24K, 2W	CGW	C42
R4052	0203 0930	composition, 75K	ALB	EB
R4053	0236 7740	140K, ±1%	CGW	N20
R4054	0236 6910	19.1K, ±1%	CGW	N20
R4055	0236 5350	453, ±1%	CGW	N20
R4056	0236 4430	49.9, ±1%	CGW	N20
R4057	0239 1406	24K, 2W	CGW	C42
R4058	0203 0640	composition, 4.7K	ALB	EB
R4300	0236 9090	wire wound, 5K, 20W	TRU	MOR-20
R4500	0203 4300	composition, 2.7M, 1W	ALB	EB
R4501 & R4502	0203 7270	composition, 2M, 2W	ALB	EB
R4503	0108 0760	variable, composition, 2.5M (FOCUS)	CLS	37
R4504	0203 1150	composition, 620K	ALB	EB
R4505	0109 1340	variable, composition, 100K, ¼W (HV ADJ)	CTS	45
R4506	0203 7270	composition, 2M, 2W	ALB	EB
R4507	0203 1150	composition, 47, ±10%	ALB	EB
R4508	0203 1610	composition, 47, ±10%	ALB	EB
R4509	0109 0080	variable, composition, 500K, ±20%, 1W (INTENSITY)	CLS	Series 53C
R4511	0203 1020	composition, 180K	ALB	EB
R4512	0203 1120	composition, 470K	ALB	EB
R4513	0234 8580	36K	CGW	C20
R4515	0234 8690	100K	CGW	C20
R4516	0203 2090	composition, 470K, ±10%	ALB	EB
R4517	0203 1610	composition, 47, ±10%	ALB	EB
R4518	0203 1030	composition, 47, ±10%	ALB	EB
R4519	0203 1610	composition, 47, ±10%	ALB	EB
R4520	0203 1690	composition, 220, ±10%	ALB	EB
R4521	0228 3980	7.5K, 3W	CGW	LP13
R4522	0203 2130	composition, 1M, ±10%	ALB	EB
R4523	0109 1340	variable, composition, 100K, ¼W (ASTIG)	CTS	45
R4524	0203 0870	composition, 43K	ALB	EB
R4525	0203 0820	composition, 27K	ALB	EB
R4526	0234 8560	30K	CGW	C20
R4527	0234 8520	20K	CGW	C20
R4528	0236 7100	30.1K, ±1%	CGW	N20
R4529	0236 6930	20K, ±1%	CGW	N20
R4531 & R4532	0203 1670	composition, 150, ±10%	ALB	EB
R4533	0234 8520	20K	CGW	C20

SWITCHES

Symbol	Part Number	Description	Recommended Vendor Code	Type
S110	0503 1330	slide, DPDT (AC/DC)	STC	SS50
S111	0501 7061	rotary, 6 positions, 3 sections, (Y VOLTS/CM)	ABD	
S112 (part of R1117)	0107 2772	SPDT, 3 amperes, 10K, ±20%, 125V (PULL VARIABLE)	ABD	
S120	0503 1330	slide, DPDT (AC/DC)	STC	SS50
S121	0501 7061	rotary, 3 sections, 6 positions (Y VOLTS/CM)	ABD	
S122 (part of R1217)	0107 2772	SPDT, 3 amperes, 10K, ±20% 125V (PULL VARIABLE)	ABD	
S123 (part of R1219)	0107 2851	DPDT, 5 amperes, 1K, ±30%, 125V (INVERT)	ABD	
S130	0503 2410	push-push, SPST (BEAM FINDER)	GRY	4002
S140	0501 7281	rotary, 5 positions, 2 sections (MODE)	ABD	
S201	0503 2390	slide, DPDT (AC/DC)	COW	126
S202 (part of S203)	0107 2771	push-pull, SPDT, 50K, ±30%, 3 amperes, 125V VARIABLE (PULL)	ABD	
S203	0501 7531	rotary, 18 positions, 3 sections, SPDT, 3 amperes, 125V (TIME/CM)	ABD	
S204 (part of R2012)	0107 2761	25K, ±30%, 25W (EXPANDER VERNIER)	ABD	
S310	0503 2140	slide, DP3T, 0.5 ampere, 125 volts, ac, dc, 3 positions (TRIG SOURCE)	MUT	No. 5608
S311	0503 2140	slide, DP3T, 0.5 ampere, 125 volts, ac, dc, 3 positions (TRG COUPLING)	MUT	No. 5608
S312	0503 1330	slide, DPDT (TRIG SLOPE)	STC	SS50
S313 (part of R3006)	0107 2741	phenolic, 2 positions, 1 section, ¼W (AUTO/VARIABLE)	ABD	
S352	0503 1330	slide, DPDT (SINGLE/NORMAL)	STC	SS50
S410	0503 2420	thermostatic (THERMAL CUTOUT)	EMW	2200
S411 (part of R4032)	0107 2344	DPST, 3 amperes, 125V (POWER)	ABD	
S415	0503 2480	slide, DPDT, 115V/230V	MUT	4633

TRANSFORMERS

T4001	2001 3791	power	ABD	
T4501	2001 3801	high voltage power supply	ABD	

ELECTRON TUBES

V1100 to V1103	2501 1610	ECC82/12AU7	AMX	
V1104 & V1105	2501 2220	6DJ8/ECC88	AMX	
V2001	2501 2220	6DJ8/ECC88	AMX	
V3001	2501 1610	ECC82/12AU7	AMX	
V3002	2501 2220	6DJ8/ECC88	AMX	
V3501 & V3502	2501 2220	6DJ8/ECC88	AMX	
V3504	2501 1550	6AU6A	EIA	
V4001 to V4003	2501 2400	6CW5/EL86	AMX	
V4004	2500 0810	5651	EIA	
V4005 & V4006	2501 3460	6BL8/ECF80	AMX	
V4501	2501 2400	6CW5/EL86	AMX	
V4502	2501 3460	6BL8/ECF80	AMX	
V4504	*2501 3880	KC2308P1	ABD	
	*2501 3890	F7010-0-P2G		
	*2501 3900	F7010-0-J2B		
	*2501 3910	F7010-0-P7		
	*2501 3920	F7010-0-P11		
	*2501 3930	F7010-0-P31		

* Depending on sales order

CABLE

W4001	5030 1390	assembly	MIL	18/3 SJT
	0905 9000	adapter connector, 125V, 15 amperes		

SECTION 6B
SPARE PARTS LIST

SPARE PARTS REQUIREMENTS

a. General

The Type 702 Oscilloscope is an extremely reliable and dependable instrument. Only components thoroughly tested and approved by the engineers of the Quality Assurance Laboratory are used in this instrument. Continued performance tests, environmental and life testing of production units make certain your oscilloscope will give many years of satisfactory service. These new Fairchild oscilloscopes are precision engineered and require no selected parts.

Two lists of "running spares" are included to aid you in periodic maintenance. The running-spare parts lists include recommended quantities and reference symbol numbers. Section 6A of this Instruction Manual gives a complete listing of all components and their recommended vendors so that you may readily procure them from a local supply house or your own stores.

Note: The local Fairchild Scientific Instrument Field Engineering representative and his service organization can assist you in obtaining any additional components in the shortest possible time. To help expediate service, always give Type Number and Serial Number of the instrument; always specify the part number and give a description of the component (see Section 6A of this manual).

b. 500-Hour Spares (6 months)

The recommended list for one through three units follows.

Fuses

Symbol	Quantity
F410	2

Electron Tubes

V1100	2
V1104	3
V3504	1
V4001	2
V4004	1
V4005	1
V4504	1

Transistors

Q1301	1
Q1303	2
Q4001	1
Q4007	1

Diodes

CR1401	5
CR3507	1
CR3508	1
CR4001	3
CR4501	1

Lamps

DS4001	1
DS4002	2
E3501	1

c. 2000-Hour Spares (2 years)

The recommended list for one through five units is given below. Maintain spares indicated plus one for each oscilloscope in use; 2 of each set of the 500-hour spare list given in paragraph (b) plus the quantities listed as follows:

Capacitors

Symbol	Quantity	Symbol	Quantity
C1101	1	C2051	1
C1102	1	C2053	1
C1103	1	C2054	1
C1104	1	C2055	1
C1105	1	C2056	1
C1106	1	C3001	1
C1107	5	C3002	1
C1108	2	C3003	1
C1110	1	C3506	1
C1111	2	C3507	1
C1113	1	C3509	1
C1201	1	C3512	1
C1213	1		
C1301	1	C4001	1
C1302	1	C4002	4
C1304	1	C4003	1
C1305	1	C4004	1
C1308	1	C4005	1
C1309	1	C4006	1
C1401	2	C4012	1
C1403	1	C4501	2
C1405	1	C4502	1
C1406	1	C4505	1
C1407	1	C4506	1
C1408	2	C4509	1
C2002	1	C4510	1
C2005	1	C4511	1
C2007	1	C4514	1
C2008	1	C4518	1
C2012	1		
C2013	1		

Lamps

Symbol	Quantity
DS4001	1
DS4002	2

Electrical Connectors

Symbol	Quantity
J1001	2
J1005	1
J4001	1
J4002	1

Resistors

Symbol	Quantity	Symbol	Quantity	Symbol	Quantity
R1101	1	R1322	1	R2031	1
R1102	1	R1323	1	R2032	1
R1103	1	R1325	1	R2033	1
R1105	1	R1326	1	R2035	1
R1106	2	R1328	1	R2036	1
R1107	2	R1331	1	R2037	1
R1109	2	R1332	1	R2038	1
R1111	7	R1401	2	R2053	1
R1112	2	R1403	1	R2055	1
R1113	2	R1405	2	R2056	1
R1115	1	R1406	1	R3001	1
R1116	1	R1411	1	R3002	1
R1118	1	R1412	1	R3003	1
R1119	1	R1413	2	R3004	1
R1120	4	R1415	1	R3005	1
R1121	2	R1416	1	R3006	1
R1124	1	R1418	2	R3007	1
R1125	1	R1423	1	R3012	1
R1128	1	R1424	1	R3013	1
R1219	1	R2003	1	R3014	1
R1301	1	R2005	1	R3015	1
R1302	1	R2010	1	R3017	1
R1306	1	R2011	1	R3018	1
R1308	1	R2012	1	R3022	1
R1311	1	R2013	1	R3023	1
R1314	1	R2015	1	R3024	1
R1315	1	R2016	1	R3025	1
R1317	1	R2017	1	R3028	1
R1319	2	R2021	1	R3512	1
R1321	1	R2027	1	R3513	1

Symbol	Quantity	Symbol	Quantity
R3518	1	R4021	1
R3521	1	R4032	1
R3522	1	R4034	1
R3525	1	R4035	1
R3528	1	R4036	1
R3530	1	R4037	1
R3531	1	R4040	1
R3535	1	R4050	1
R3537	1	R4051	1
R3538	1	R4052	1
R3539	1	R4054	1
R3540	1	R4055	1
R3543	1	R4056	1
R3544	1	R4500	1
R3546	1	R4501	1
R3547	1	R4503	1
R4000	1	R4504	1
R4001	1	R4505	1
R4002	1	R4507	1
R4003	1	R4508	2
R4004	1	R4509	1
R4005	1	R4511	1
R4007	1	R4513	1
R4008	1	R4515	1
R4009	1	R4516	1
R4011	1	R4518	1
R4012	1	R4520	1
R4013	1	R4521	1
R4014	1	R4524	1
R4015	1	R4526	1
R4016	1	R4527	1
R4017	1	R4528	1
R4018	1	R4529	1
R4019	1	R4531	1

Transformers

Symbol	Quantity
T4001	1
T4501	1

Switches

Stock only one each of the following switches for each 3 units being maintained:

S110, S111, S130, S140, S201
S203, S310, S410, S415

NOTE: Should a particular switch receive more than normal use in certain applications (such as the BEAM FINDER) then the quantity stocked of that particular switch should be doubled.

d. Miscellaneous

The following items may be stocked in quantities of one for each 2 units being maintained:

Name	Function	Part Number
Bumper, rubber, black	—	3802 3120
Bushing, shaft	(X Bal)	4301 3581
Connector, adapter	—	0905 9000
Fuseholder	—	1100 1890
Knob, binding post	(A Input)	4500 7131
Knob, black	(Mode)	4501 0400
Knob, black	(Y Volts/Cm)	4501 0380
Knob, round, black	(Position)	4501 0390
Knob, red	(Time/Cm)	4501 0410
Knob, ring, front	—	4501 0441
Light, jewel, red	—	1201 2010
Panel, front	—	3201 3622
Power cord	—	5030 1390
Strap, ground	—	3701 3141

e. Summary

The quantities of spare parts given in the preceding paragraphs are intended for industrial and military duty under normal environment and heavy-use conditions. It is suggested that the maintenance engineer evaluate:

1. The conditions under which the instruments will be used.
2. The skill of the maintenance technicians.
3. Other similar items on hand.
4. The effect of procurement time of spares and effects of instrument down-time on your organization.

It is recommended that inventories of spare parts outlined above be adjusted according to the requirements of your own laboratory or plant.

In the first analysis, the factory recommends the availability of spares or standby equipments since extensive life testing of your instrument has shown no higher failure rate for any specific component.

LIST OF RECOMMENDED VENDORS

CODE	NAME
ABD	Du Mont Laboratories
AER	Aerovox Corporation
AHH	Arrow-Hart & Hegeman Electric Company
ALB	Allen-Bradley Company
ALC	Allied Control
ALCO	Alco Electronic Products
ALD	Alden Products Company
AMA	Amaton Electronic Hardware
AMP	Amp Inc.
AMR	Amperite Company, Inc.
AMX	Amperex Electronics Products, Inc.
APC	American Phenolic Corporation
APH	Amphenol Electronics Corporation
ARC	Arco Electronics Inc. (Elmenco)
AST	Astron Corporation
AUT	Automatic Metal Products Corporation
BNS	Bourns Inc.
BUR	Burndy Engrg. Company
BUS	Bussmann Mfg. Company
CAN	Cannon Electric Company
CBS	CBS-Hytron Division of CBS
CDE	Cornell-Dubilier Electric Corporation
CGW	Corning Glass Works
CH	Cutler-Hammer, Inc.
CHC	Chester Cable Corporation
CHM	Chatham Electronics
CIN	Cinch Manufacturing Company
CLS	Clarostat Mfg. Co., Inc.
COC	Continental Carbon (Division of Wirt Company)
COW	Continental-Wirt Electronics Corporation
CPC	C. P. Clare & Company
CRL	Centralab, Division of Globe-Union, Inc.
CST	Chicago Standard Transformer Corporation
CTC	Cambridge Thermionic Corporation
CTS	Chicago Telephone Supply Corporation
DAG	Dage Electric Company, Inc.
DAL	Dale Products, Inc.
DLC	Dialight Corporation
DRK	Drake Mfg. Company
EBY	Hugh H. Eby, Inc.
EDL	Edal Industries
EIA	Any manufacturer meeting EIA standards
ELC	Electra Manufacturing Company
ELD	Eldema Corporation
ELM	Elmenco
EMC	Electro Motive Mfg. Company
EMW	Elmwood Sensors, Inc.
ERC	Erie Technological Products, Inc.
ESX	Essex Electronics
FCI	Fairchild Camera and Instrument Corporation
FER	Ferroxcube Corporation of America
GDE	Good-All Electric Mfg. Company
GE	General Electric Company
GEN	General Instrument Corporation
GEP	General Products Corporation
GRC	General Radio Company
GRY	Grayhill, Inc.
GUD	The Gudeman Company
HAM	The Hammarlund Manufacturing Co. Inc.
HON	Honeywell
HOP	Hopkins Engineering Company

CODE	NAME
HP	Hewlett-Packard Company
IRC	International Resistance Company
IRP	International Rectifier Corporation
ITT	International Telephone and Telegraph Corporation
JEF	Jeffers Electronics, Inc.
JHN	E. F. Johnson Company
JWM	J. W. Miller Company
KUL	Kulka Electric Mfg. Co. Inc.
KXM	Klixon Metals and Control Corporation
LED	Ledex Inc.
LEE	Leecraft Mfg. Company
LIN	Line Electric
LFI	Littlefuse, Inc.
MAL	P. R. Mallory & Company, Inc.
MCR	Micro Switch (Division of Minneapolis-Honeywell Regulator Co.)
MIC	Micamold Electronics Mfg. Corporation
MIL	Miller Electric Company
MOV	M-O Valve Company Ltd.
MOT	Motorola Semiconductor Products, Inc.
MUC	Mucon Corporation
MUL	Mullard Limited
MUT	The Muter Company
NYT	New York Transformer Company, Inc.
OAK	Oak Mfg. Company
PHC	Philco Corporation
PHI	Philips Electronic Tube Division
PLS	Plastoid Corporation
POT	Potter & Brumfield, Inc.
PRC	Precision Resistor Co., Inc.
PYR	Pyramid Electric Company
RCA	Radio Corporation of America
RMC	Radio Materials Corporation
ROY	Royal Electric Corporation, Inc.
RTN	Rotron Mfg. Company
SIG	Signalite Inc.
SIL	Silicon Transistor Corporation
SLT	Sealectro Corporation
SOL	Solitron Devices, Inc.
SPG	Sprague Electric Company
STC	Stackpole Carbon Company
STW	Standard Winding Company
SUM	Summit Coil Company
SWT	Switchcraft Inc.
SWW	Stanwyck Winding Company
SYL	Sylvania Electric Products, Inc.
SYN	Syntronic Instruments, Inc.
TEC	Transistor Electronics Corporation
TEX	Texas Instruments, Inc.
THC	Thermal Control, Inc.
TOR	Torrington Mfg., Company
TRS	Tresco, Inc.
TRU	Tru-Ohm Products
TUG	Tung-Sol Electric Inc.
UCN	Ucinite Company
UTC	United Transformer Company
VIC	The Victoreen Instrument Company
WDE	Wood Electric Corporation
WDL	Ward Leonard Electric Company
WES	Weston Electrical Instrument Corporation
WYN	Welwyn International Inc.

INSTRUMENT WARRANTY AND SERVICE NOTICE

WARRANTY

The Scientific Instrument Department warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Fairchild, the Instrument is determined to be defective in workmanship or material, Fairchild will, subject to the conditions set forth below, either repair the defective part or replace it with a new part. Fairchild shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Fairchild be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Fairchild service organization or an employee thereof, or to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond, the continental limits of the United States.

This warranty shall, at Fairchild's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Fairchild or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

REGISTERING THE WARRANTY

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to the Instrument Service Department immediately upon receipt of the equipment. Complete information is necessary. BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD. Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is requested, please first contact the factory or authorized depot, giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

FAIRCHILD
Du Mont Laboratories
Scientific Instruments Dept.
750 Bloomfield Avenue, Clifton, New Jersey

The Instrument Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Fairchild part number for all electrical components used in the Instrument. This will help to expedite service.

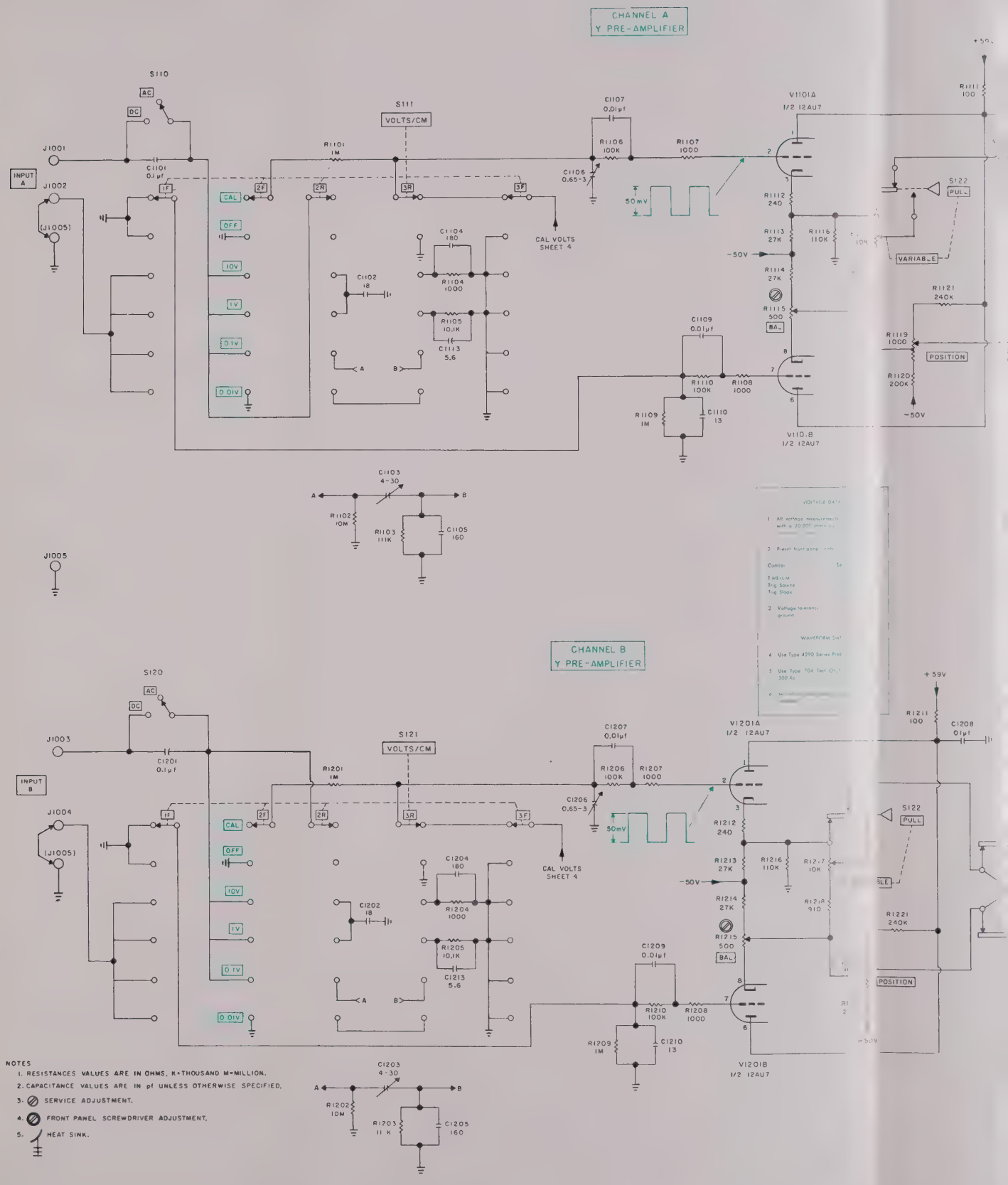
PATENT NOTICE

Manufactured under one or more U. S. Patents owned or controlled by Fairchild Camera and Instrument Corporation, 750 Bloomfield Avenue, Clifton, New Jersey, U.S.A. Patent Numbers supplied upon request.

WARRANTY REGISTRATION
IMPORTANT—FILL OUT AND MAIL THIS CARD—NO STAMP REQUIRED
EQUIPMENT WAS PURCHASED BY
SEE INSTRUCTION MANUAL FOR WARRANTY NOTICE
YOU UNLESS MAILED WITHIN 30 DAYS AFTER RECEIPT

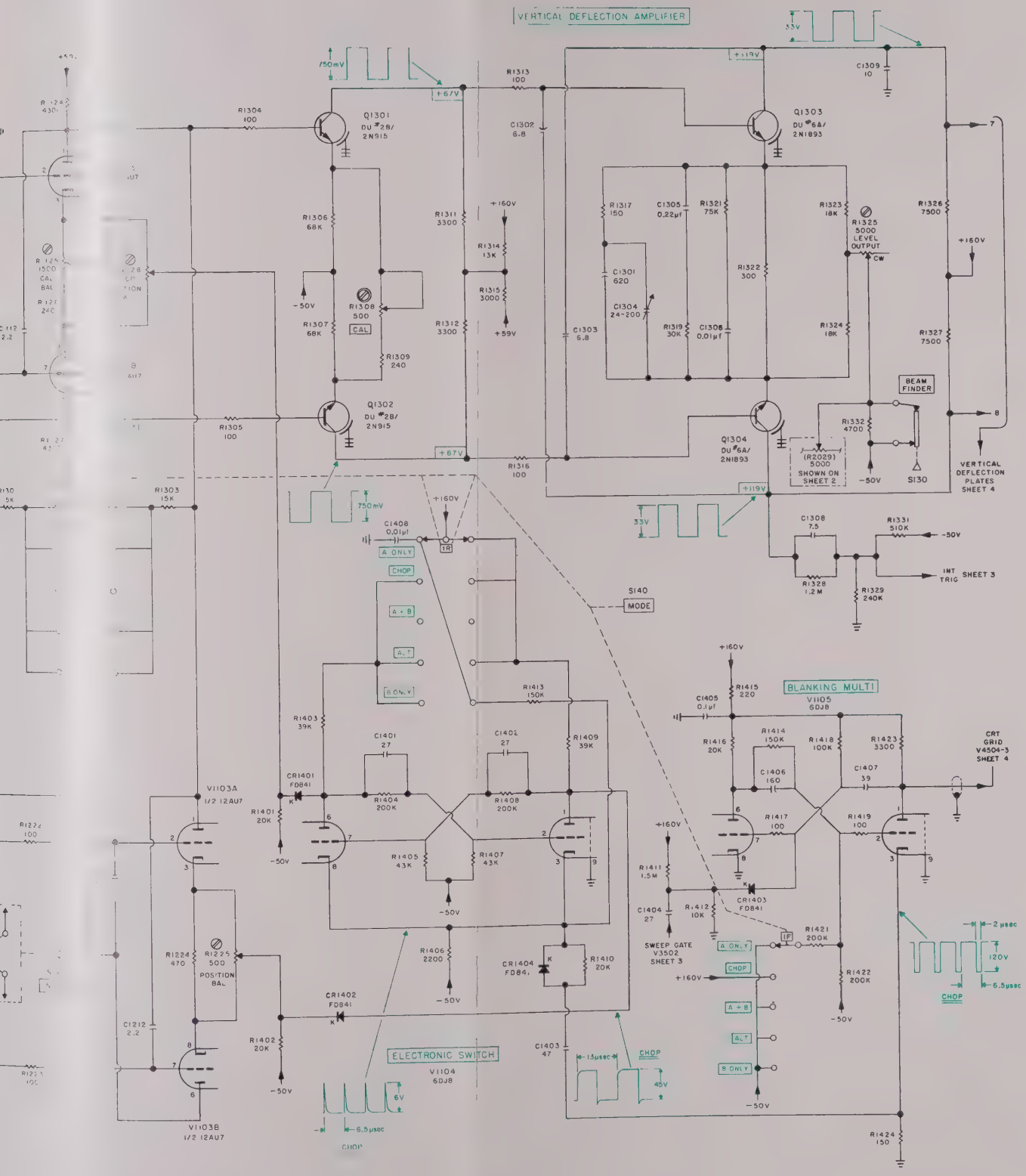
NOTES

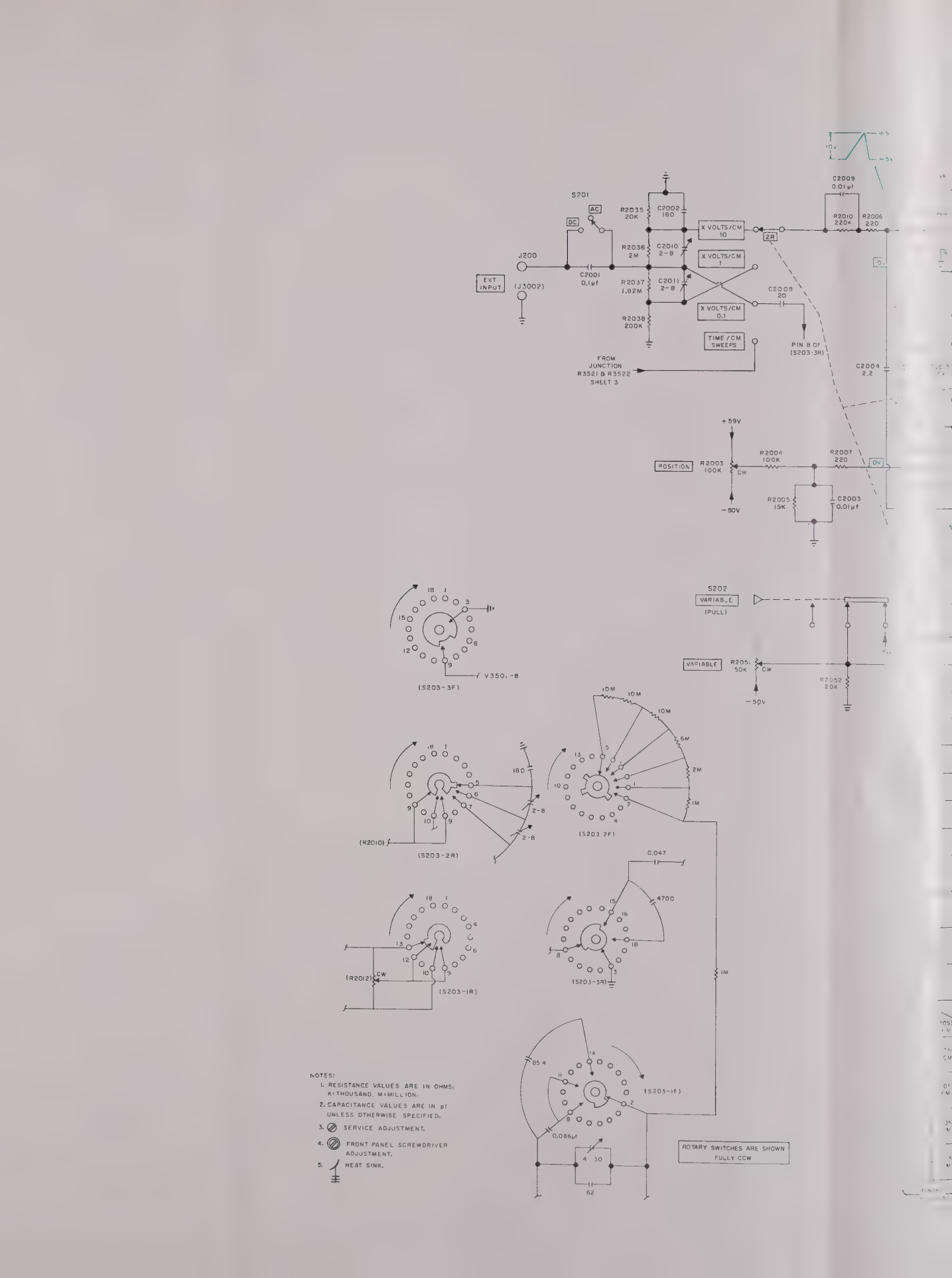
NOTES

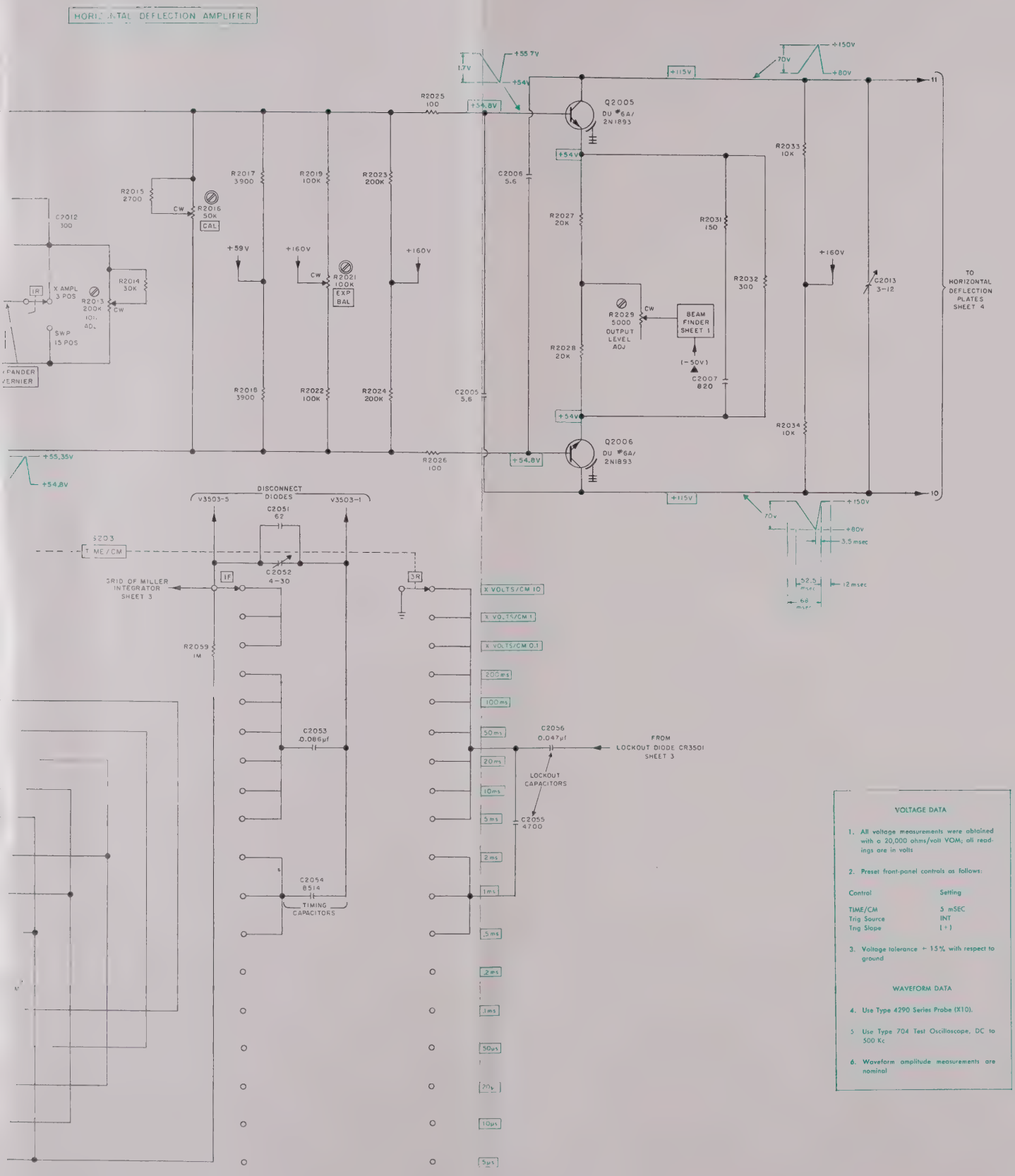


NOTES

1. RESISTANCES VALUES ARE IN OHMS, K=THOUSAND M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
5. ⏚ HEAT SINK.


VERTICAL DEFLECTION AMPLIFIER
Q1301 DU #2B/ 2N915
Q1302 DU #2B/ 2N915
Q1303 DU #6A/ 2N1893
Q1304 DU #6A/ 2N1893
R1304 100
R1305 100
R1306 68K
R1307 68K
R1308 500 CAL
R1309 240
R1311 3300
R1312 3300
R1313 100
R1314 13K
R1315 3000
R1316 100
C1302 6.8
C1303 6.8
R1317 150
C1305 0.22µf
R1321 75K
R1323 18K
R1325 5000 LEVEL OUTPUT CW
R1326 7500
C1301 620
C1304 24-200
R1322 300
R1319 30K
C1306 0.01µf
R1324 18K
R1327 7500
BEAM FINDER
R1332 4700
(R2029) 5000 SHOWN ON SHEET 2
SI30
VERTICAL DEFLECTION PLATES SHEET 4
C1309 10
+160V
+119V
+67V
+59V
-50V
33V
750mV
C1308 7.5
R1328 1.2M
R1331 510K
R1329 240K
INT TRIG SHEET 3
R1303 15K
C1408 0.01µf
TR
A ONLY
CHOP
A+B
ALT
B ONLY
SI40 MODE
R1413 150K
R1403 39K
C1401 27
C1402 27
R1409 39K
CR1401 FD841
R1404 200K
R1408 200K
R1401 20K
V1103A 1/2 12AU7
R1405 43K
R1407 43K
R1224 470
R1225 500 POSITION BAL
R1406 2200
CR1404 FD841
R1410 20K
CR1402 FD841
C1212 2.2
R1402 20K
V1103B 1/2 12AU7
ELECTRONIC SWITCH
V1104 6DJ8
C1403 47
1.5µsec
45V
6V
6.5µsec
BLANKING MULTI
V1105 6DJ8
R1415 220
C1405 0.1µf
R1416 20K
R1414 150K
R1418 100K
R1423 3300
C1406 160
C1407 39
CRT GRID V4504-3 SHEET 4
R1417 100
R1419 100
R1411 1.5M
R1412 10K
CR1403 FD841
C1404 27
SWEEP GATE V3502 SHEET 3
1F
R1421 200K
R1422 200K
2 µsec
120V
6.5µsec
R1424 150


S201
AC
DC
J200
EXT INPUT
(J3002)
C2001 0.1µf
R2035 20K
C2002 180
R2036 2M
C2010 2-8
R2037 1.82M
C2011 2-8
R2038 200K
X VOLTS/CM 10
X VOLTS/CM 1
X VOLTS/CM 0.1
TIME/CM SWEEPS
2R
C2009 0.01µf
R2010 220K
R2006 220
C2009 20
PIN 8 OF (S203-3R)
FROM JUNCTION R3521 & R3522 SHEET 3
C2004 2.2
+59V
POSITION
R2003 100K
CW
-50V
R2004 100K
R2007 220
0V
R2005 15K
C2003 0.01µf
S202
VARIABLE (PULL)
VARIABLE
R2051 50K
CW
-50v
R2052 20K
V350.-8
(S203-3F)
10M
2.6M
2M
1M
(S203 2F)
180
2-8
(R2010)
(S203-2R)
0.047
4700
(S203-3R)
(R2012)
CW
(S203-1R)
1M
85.4
(S203-1F)
0.086µf
4 30
62
ROTARY SWITCHES ARE SHOWN FULLY CCW
NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. SERVICE ADJUSTMENT.
4. FRONT PANEL SCREWDRIVER ADJUSTMENT.
5. HEAT SINK.



VOLTAGE DATA

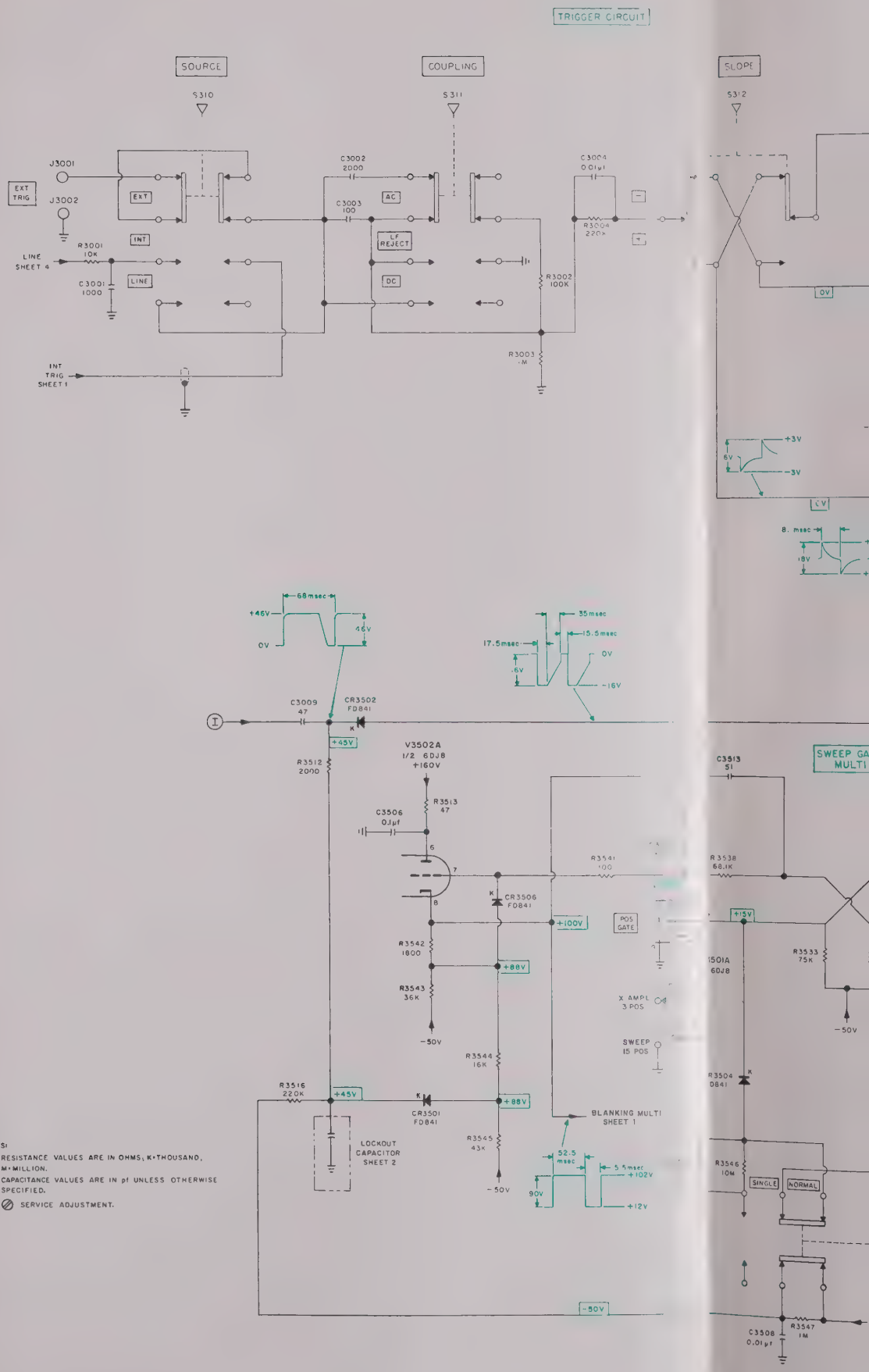
1. All voltage measurements were obtained with a 20,000 ohms/volt VOM; all readings are in volts
2. Preset front-panel controls as follows:

Control	Setting
TIME/CM	.5 mSEC
Trig Source	INT
Trig Slope	(+)

3. Voltage tolerance ± 15% with respect to ground

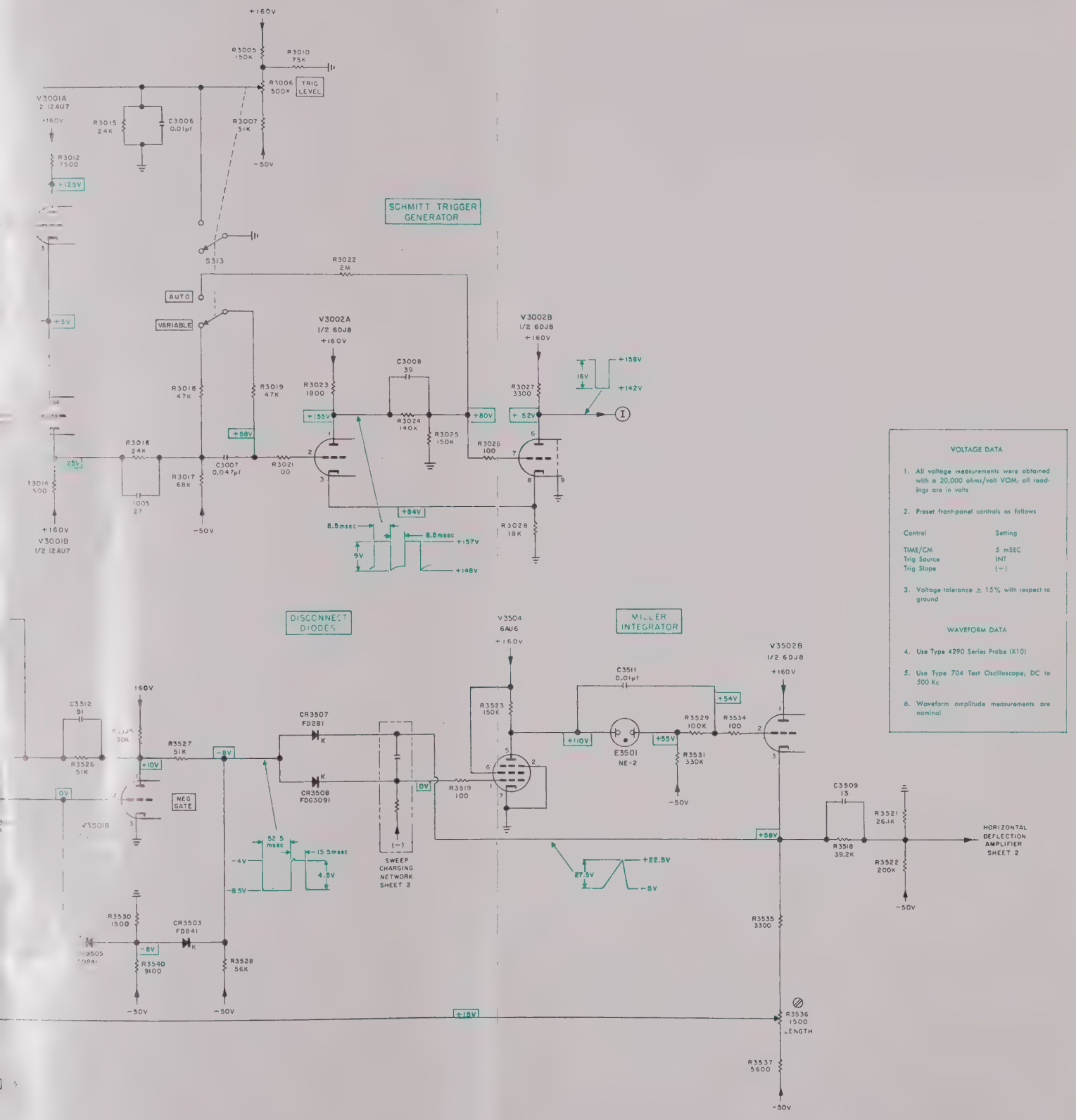
WAVEFORM DATA

4. Use Type 4290 Series Probe (X10).
5. Use Type 704 Test Oscilloscope, DC to 500 Kc
6. Waveform amplitude measurements are nominal



NOTES:

1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.



VOLTAGE DATA

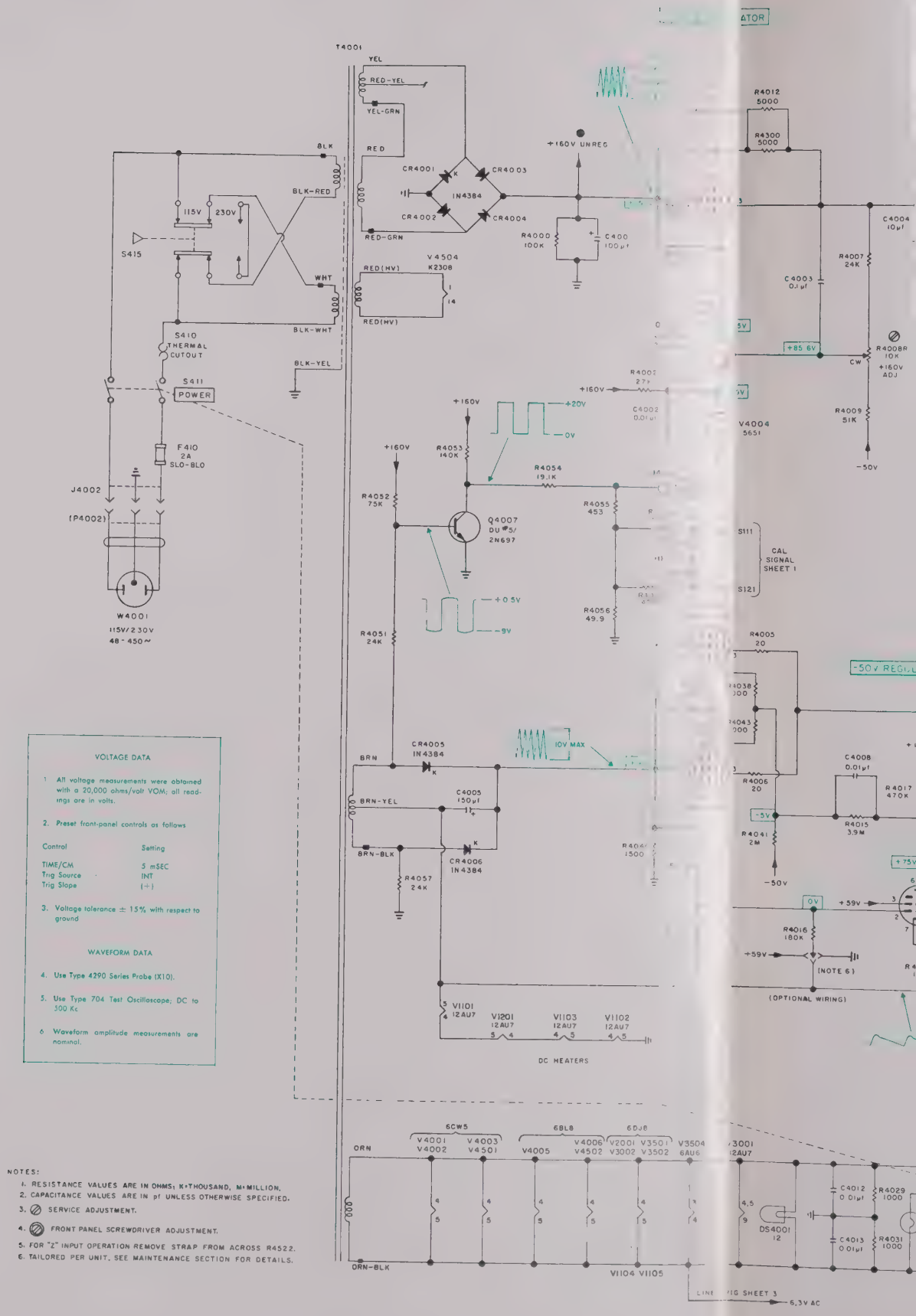
1. All voltage measurements were obtained with a 20,000 ohms/volt VOM; all readings are in volts
2. Preset front-panel controls as follows

Control	Setting
TIME/CM	5 mSEC
Trig Source	INT
Trig Slope	(+)

3. Voltage tolerance ± 15% with respect to ground

WAVEFORM DATA

4. Use Type 4290 Series Probe (X10)
5. Use Type 704 Test Oscilloscope; DC to 500 Kc
6. Waveform amplitude measurements are nominal



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volt VOM; all readings are in volts.
2. Preset front-panel controls as follows

Control	Setting
TIME/CM	5 mSEC
Trig Source	INT
Trig Slope	(+)

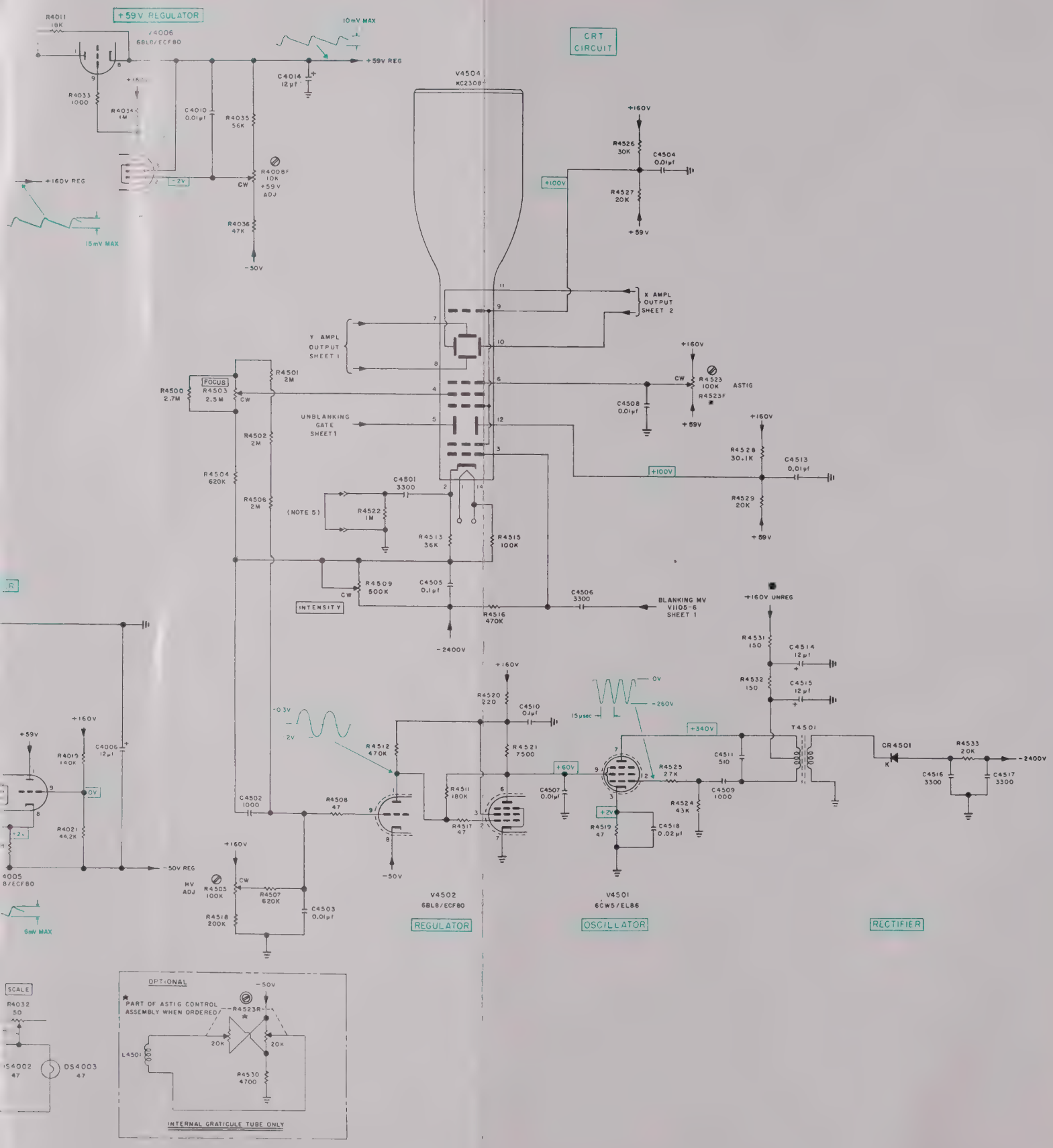
3. Voltage tolerance ± 15% with respect to ground

WAVEFORM DATA

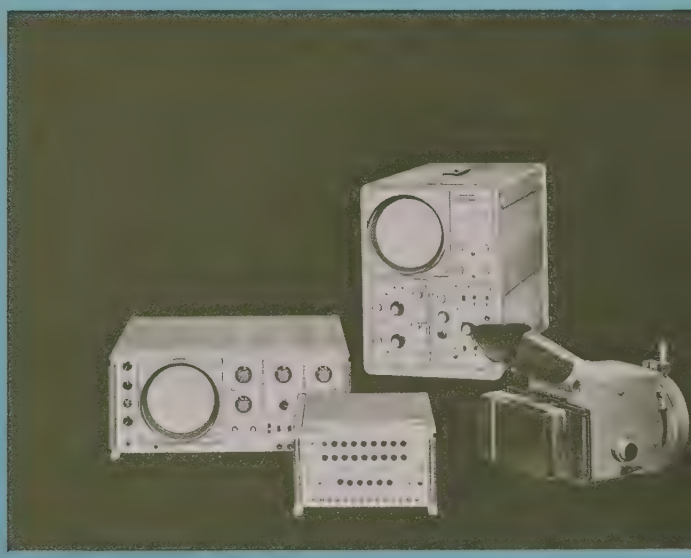
4. Use Type 4290 Series Probe (X10).
5. Use Type 704 Test Oscilloscope; DC to 500 Kc.
6. Waveform amplitude measurements are nominal.

NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
5. FOR "Z" INPUT OPERATION REMOVE STRAP FROM ACROSS R4522.
6. TAILORED PER UNIT. SEE MAINTENANCE SECTION FOR DETAILS.


+59V REGULATOR
CRT CIRCUIT
V4504 KC2308
V4502 6BL8/ECF80 REGULATOR
V4501 6CW5/EL86 OSCILLATOR
RECTIFIER
+59V REG
-50V REG
+160V REG
+160V UNREG
+100V
+340V
+60V
+2V
-2400V
-50V
X AMPL OUTPUT SHEET 2
Y AMPL OUTPUT SHEET 1
UNBLANKING GATE SHEET 1
BLANKING MV V1105-6 SHEET 1
ASTIG
FOCUS
INTENSITY
HV ADJ
(NOTE 5)
OPTIONAL
PART OF ASTIG CONTROL ASSEMBLY WHEN ORDERED
INTERNAL GRATICULE TUBE ONLY
10mV MAX
15mV MAX
6mV MAX
0.3V
2V
0V
-260V
15μsec
R4011 18K
R4033 1000
R4034 1M
C4010 0.01μf
R4035 56K
R4008F 10K +59V ADJ
R4036 47K
C4014 12μf
R4526 30K
C4504 0.01μf
R4527 20K
R4523 100K ASTIG
R4523F
C4508 0.01μf
R4528 30.1K
C4513 0.01μf
R4529 20K
R4501 2M
R4500 2.7M
R4503 2.5M
R4502 2M
R4504 620K
R4506 2M
C4501 3300
R4522 1M
R4513 36K
R4515 100K
R4509 500K
C4505 0.1μf
R4516 470K
C4506 3300
R4531 150
C4514 12μf
R4532 150
C4515 12μf
R4520 220
C4510 0.1μf
R4521 7500
R4512 470K
C4502 1000
R4508 47
R4511 180K
R4517 47
C4507 0.01μf
R4525 27K
C4511 510
C4509 1000
R4524 43K
R4519 47
C4518 0.02μf
T4501
CR4501
R4533 20K
C4516 3300
C4517 3300
R4505 100K
R4507 620K
R4518 200K
C4503 0.01μf
R4015 140K
C4005 12μf
R4021 44.2K
R4032 50
DS4002 47
DS4003 47
L4501
R4530 4700
20K
-50V
SCALE

SCIENTIFIC INSTRUMENTS



SHORT FORM CATALOG • NUMBER 130

FAIRCHILD

DU MONT LABORATORIES
SCIENTIFIC INSTRUMENT DEPARTMENT

TYPE 700 X-Y INDICATOR

low cost ■ self calibrating ■ 1° phase shift between X & Y axis (DC-100 kc) ■ 10 x 10 cm display ■ identical X & Y amplifiers ■ −40°C to 85°C storage, 0°C to 50°C operating

Sensitivity—100 mv/cm, 2 cal positions, 1V & 10V/cm
Bandwidth—350 kc both X-Y
Phase Shift—at cal gain X-Y adjustable to ±1° from DC to 100kc, when 0° @ 50 kc ±3°
Stability—less than 2 mm drift avg/8 hrs (controlled amb & line voltage)
Z Axis—Option Z axis input −25V to blank trace, Kit 7088
Power—115 or 230V uses approx 85W, 48-450 cps
Input—1 meg shunted by 45 pf

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5 cm) D, 26.5# **$420.00**

TYPE 701 GENERAL PURPOSE SCOPE

10mv/cm ■ DC-500 kc BW ■ 10 x 10cm display ■ under 30 pounds ■ X1 to X10 continuous expansion ■ easy-lock trigger circuits ■ semiconductor amplifier stability

Vertical Amplifier—10mv to 10V/cm in 4 decade steps, control for 10-1 sensitivity adjust, com mode reject exceeds 100-1 (40db), sig ampl should not exceed 6V p-p (±3V DC), X-Y adjustable ±1° DC to 100 kc, 1 meg x 47pf
Horizontal Amplifier—10mv to 10V/cm sensitivity, 2 cals .1V/cm & 1V/cm, 10-1 variable for range .1V to 10V/cm continuous adjust; DC to 350 kc BW, down 3 db
Time Base—Sweep cal 5μs to 200ms/cm in 15 steps 1,2,5 sequence, pull variable extends slowest to 1 sec/cm, cont expand X1 to X10, fastest .5μs/cm
Other—115V or 230V line, 145W const line freq 48-450 cps, 0° to 50°C operate, bench or rack use

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5cm) D, 29.5# **$450.00**

TYPE 702 DUAL TRACE SCOPE

10mv/cm ■ DC to 500kc BW ■ bench or rack ■ 10 x 10cm display ■ dual trace ■ transistorized amplifier stability ■ trigger circuits lock easily ■ modular design

Vertical Amplifier—10 mv to 10V/cm sensitivity, 4 decade steps, 1meg by 44pf single ended; operates ChA only, ChB only, chop, A±B, −2mv drift/hr
Horizontal Amplifier—.1 to 10V/cm sensitivity, variable extends range to 10V/cm
Time Base—Sweep cal 5μs−200ms/cm, 15 steps 1,2,5 seq, 3% accuracy; cont exp X1 to X10, fastest to .5μs/cm, 50 cps auto sync, ±10V trigger level control on external
Display—5" flat face CRT, high brightness, int graticule option, 2.5kv accel potential, push button beam finder, Z axis option (Kit 7088)
Other—115 or 230V power, 175W, 48-450 cps, 0° to 50° operate

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5cm) D, 29.5# **$660.00**

TYPE 704 HI GAIN X-Y SCOPE

matched X-Y amplifiers ■ 200μv/cm ■ DC-500 kc BW ■ 10 x 10cm display ■ balanced or single-ended input all ranges ■ X50 sweep expand ■ simple panel controls ■ electrometer input for amplifier stability

Amplifiers—200μv to 20V/cm sensitivity, 16 steps 1,2,5 seq, 2½-1 variable between 200μv and 50V/cm; DC-500kc down 3db; selector switch for A only, -B only, Diff A-B; 5cm cal sig built-in, 3% accuracy; 100-1 (40db) CMR from .2-20mv/cm, at least 20db all other; phase shift X-Y adjusts to ±1° DC to 100kc; DC or AC coupling, input sig 600V p-p or DC; input impedance 1meg x 50pf single-ended, 2meg x less than 40pf balanced input
Time Base—Sweep cal 5μs to 2sec/cm, 18 steps 1,2,5 seq, 3% accuracy, variable extends slowest sweep to 6sec/cm; 6-step sweep expander from X1 to X50, accurate to 5% for rates to 1μs/cm; trigger from int, ext & line on pos or neg slopes; trigger on 5mm of vert deflection and 500mv p-p ext; auto sync @ 50cps; ±10V trigger leveling on external
Display—5" flat faced CRT, mono-accel high brightness, deflection unblanking; P31 phos (P2,7,11 on request); accel potential 2.5kv; push button beam finder; Z axis option with Kit 7088
Other—115 or 230V, 170W, 48-450cps; −40° to 85°C stored, 0° to 50°C operate

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5cm) D, 32# **$645.00**

TYPE 403-B HI SENSITIVITY SCOPE

50μv/cm ■ .7μs risetime ■ AC stability control ■ 10 x 10cm display ■ 5kv CRT ■ most sensitive scope commercially available ■ exceptional stability

Vertical Amplifier—50μv/cm-20v/cm sensitivity in 17 cal steps, DC coupled; input imp 1 meg x 47pf; AC stabilizer control for drift-free input; stable to 500μv/hr over 8 hrs; diff input all ranges, 2meg shunted by under 47pf; CMR 100-1 (40db)
Horizontal Amplifier—10mv/cm to 100V/cm sensitivity in 4 decade steps, DC-500kc down 3 db, DC coupled; input imp 1 meg x 47pf; under 1mv/hr drift over 8 hrs
Time Base Generator—Sweep 1μs/cm-5sec/cm 21 cal steps, vernier extends slowest to 25sec/cm; X5 expander extends fastest to .2μs/cm; sync from int, ext & line on + or − slopes (auto-trigger available); trigger sensitivity 5mm of vert deflection @ 250mv p-p ext; ±12v trigger level
Other—K1931 5kv CRT, P31 phosphor (P1,2,7,11 available); metallized screen option for max light output; 115/230v, 48-450 cps, 230w

8¾" (22.3cm) W x 15½" (39.4cm) H x 23¼" (59.2cm) D, 45# **$760.00**

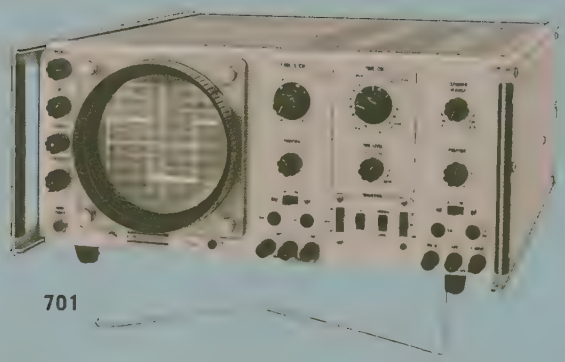
Rack Mount—Type 403-BR (front panel input terminals duplicated rear of rack unit)

19" (48.4cm) W x 7" (17.8cm) H x 21¼" (53.9cm) D, 45# **$760.00**

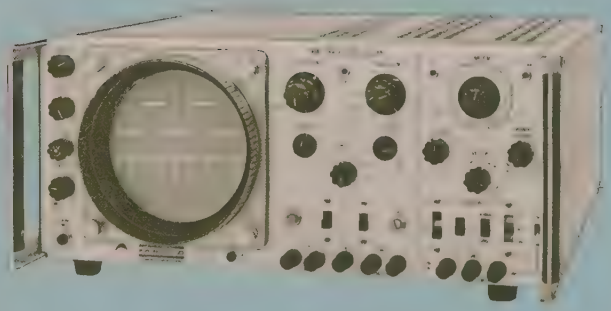
FAIRCHILD

Types
700
701
702
704
403-B
403-BR

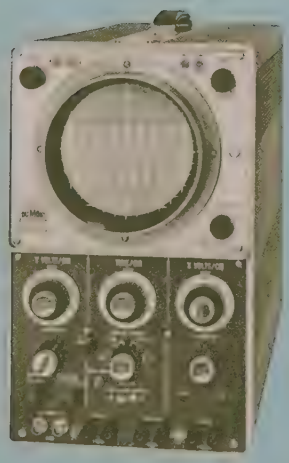
700



701



702



403-B

704

FAIRCHILD

Types
765H
766H
767H
757
765MH
777

TYPE 765-H SOLID STATE HIGH FREQUENCY SCOPES

13kv acceleration ■ 6 x 10 cm display ■ 200w consumption ■ silicon circuitry ■ dual plug-ins (DC to 100 mc) ■ X & Y plug-ins interchangeable ■ CRT and power supply in main frame ■ signal circuitry in plug-ins ■ extreme reliability in all environments ■ 48-450cps line ■ no fan

Display—5" flat face post accelerator CRT, 13kv potential; frame grid gives minimum defocusing and spot size; P31 phosphor (P2,7,11 option); 5kv post accel CRT or internal graticule on request; CRT grid accessible thru connectors at rear; 360° joystick positioning of CRT display
Temperature— −40° to +85°C stored, 0° to +50°C operate; thermostat cuts power when ambient limits are exceeded
Humidity—95% @ 40°C; intermittent all conditions without condensation
Vibration and Shock—Vibration 15-min cycle 10-33cps, 3 planes 15-min each 2G limit; Shock 10G for 25ms
Altitude—15,000′ oper, 50,000′ non-oper 5kv; 10,000′ oper, 50,000′ non-oper 13kv units

8¼" (21cm) H x 16¾" (45cm) W x 23" (58.5cm) D, 27# net, 37# shipping; Main Frame Type 765H **$720.00**
Type 765 with 5kv option **$645.00**

Type 766H
13¾" (35cm) H x 9¾" (24.8cm) W x 20⅝" (52.5cm)
Main Frame Type 766H **$595.00**
Type 766 with 5kv option **$545.00**

Type 767H
7" (17.8cm) H x 16⅜" (41.5cm) W for 19" rack x 20" (51cm) D behind panel; Main Frame Type 767H.. **$695.00**
Type 767 with 5 kv option **$595.00**

TYPE 757 HI WRITING RATE SCOPE

4000cm/μs photo recording ■ normal and hi writing rate ■ lowest cost on market ■ use all 76-00 and 74-00 plug-ins ■ DC to 100 mc, T_r 3.5ns ■ 7" rack height ■ 4 x 5cm scan (14kv) ■ solid state circuitry ■ horizontal scan 10 div of 4mm each ■ 150 line vertical and 175 line horizontal resolution ■ normal to fast single shot switch ■ CRT beam cutoff cuts film fog on time exposure

Display—5" flat faced post accel CRT, 14kv accel poten, 8-10mil spot, P11 phosphor for max photo efficiency
Z Axis—Connectors at rear give access to CRT grid
Temperature— −40° to +85°C stored; 0° to +50°C operate; thermostat cuts power when ambient limits reached
Altitude—10,000′ operational, 50,000′ non-operational
Power—115/230v, 200w, 48-450cps

7" (17.8cm) H x 16⅜" (43cm) W x 21" (54cm) D, 27# net, 37# shipping; Main Frame **$950.00**

TYPE 765-MH MILITARIZED PORTASCOPE®

rugged ■ meets MIL specs ■ 48-450 cycles ■ low power use ■ −30° to +60°C ■ solid state circuitry ■ light and portable ■ RFI shielded ■ vibration tested ■ certificate of compliance included ■ FSN 6625-056-7115 ■ fiberglas case ■ carrying handle ■ fiberglas cover for mounting accessories ■ two cavities for X & Y plug-ins ■ electrically identical to 765H series

Heater Strips—200w thermostatic heater for low temp below 0°C
Temperature— −40°-+85°C stored, −30° to +50°C oper without fan, −30° to +60°C oper with fan (mod 101)
Altitude—15,000′ oper, 50,000′ non-oper
Humidity—95% relative @ 40°C, MIL 202B method 106A except freeze
Shock—20G @ 5ms, 15G @ 11ms, 10G @ 25ms
Vibration—15-min cycle 10-3000cy @ .01" dbl ampl p-p, .025" 5-min, 15-min ea plane with 30-sec cycle

8¼" (20.8cm) H x 17¾" (45cm) W x 23" (58.5cm) D with cover, 27# net, 37# shipping

Main Frame Type 765MH **$985.00**
Type 765M with 5kv option **$895.00**
Mod 101 ..... **$195.00** additional

TYPE 777 DUAL BEAM SCOPE

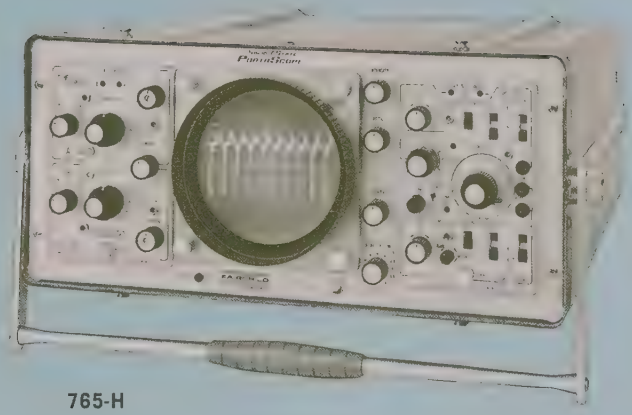
2 independent beams ■ 2 independent deflection systems ■ 13kv accelerating ■ 44 pounds ■ DC to 100 mc ■ 6 x 10 cm display each beam ■ use in 14" rack ■ solid state circuitry ■ high frequency ■ use all 74-00 and 76-00 plug-ins ■ no intermediate stages with all signal circuits in plug-ins ■ panel area for special systems controls

Display—13kv dual gun CRT 5" flat face metallized, 2 independent gun structures; Faraday shield for min spot size and defocus; P31 phosphor (P2,7,11 optional); 6 x 10cm each beam, 5cm overlap, adjustable edge lighted graticule; 2 CRT grids accessible @ rear
Temperature— −40° to +85°C stored; 0° to 50°C operate
Altitude—10,000′ operate, 50,000′ non-operate
Humidity—Constant operation at 95% relative humidity and 40°C
Shock—10G for 25ms
Power—115/230v, 350w, 48-62cps, 48-450 cps with mod 101

13⅞" (35cm) H x 16⅜" (41.3cm) W x 21" (53.3cm) D, 44# net, 64# shipping
Main Frame Type 777 ..... **$1,600.00**

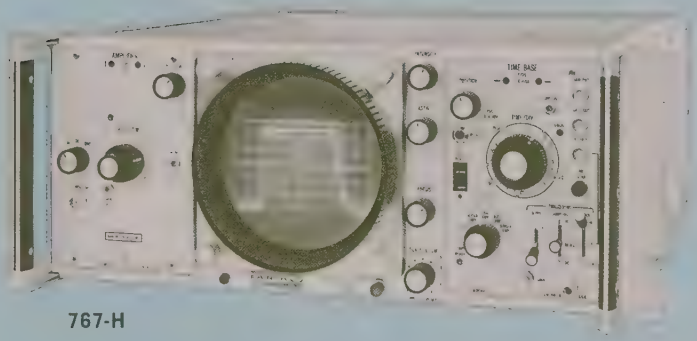
FAIRCHILD

Types
765H
766H
767H
757
765MH
777



765-H

766-H



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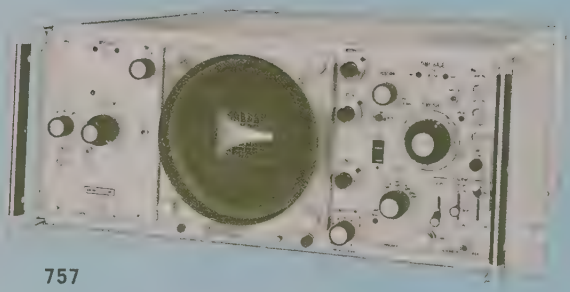

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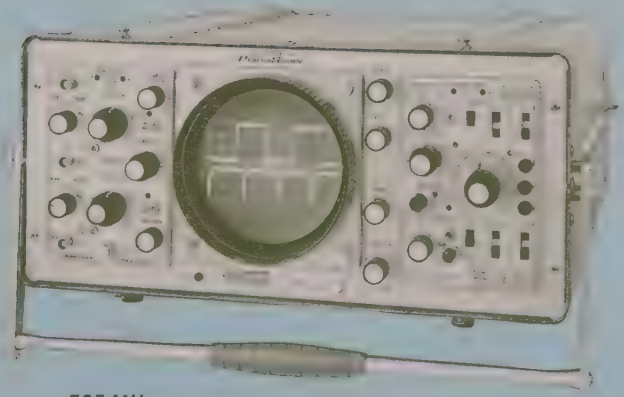

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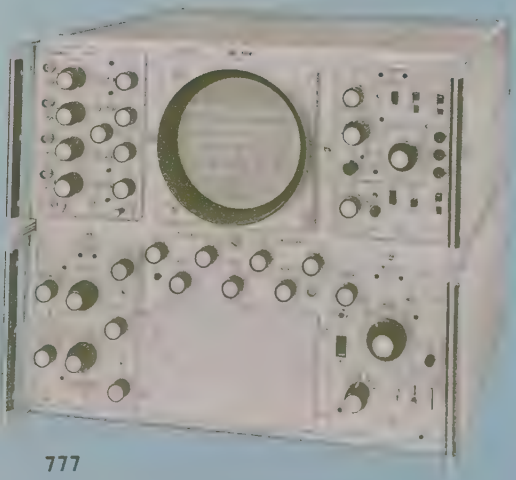
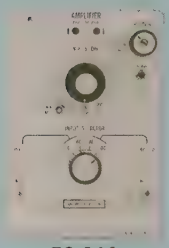


777

FAIRCHILD

PLUG-INS

765 SERIES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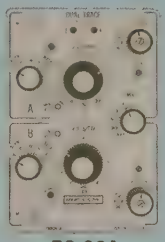
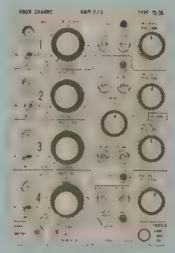

76-02A

76-03

76-05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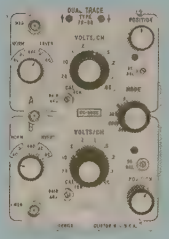
76-07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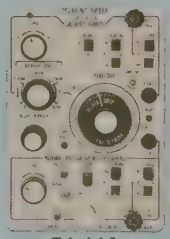
74-12

74-15

74-19

74-03A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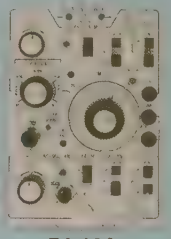
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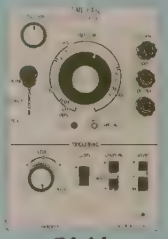
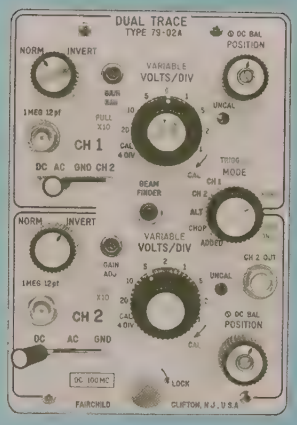

74-14

Plug-Ins, 765 SERIES

Type	Description	Vertical Band Pass	Risetime	Sensitivity	Signal Delay	Scan	Price
76-01A	Single Trace	DC-25mc	14.5ns	5mv-10v/div	(230ns) option	6 cm	$385.00 $460.00 with signal delay
76-02A	Dual Trace A,B,Alt, Chop, A±B	DC-25mc	14.5ns	5mv-10v/div	(230ns) option	6 cm	$475.00 $550.00 with signal delay
76-03	Single Trace	DC-50mc	7.5ns	50mv-20v/div	230ns	6 cm	$450.00
76-05	100mc	DC-100mc	3.5ns	5v-7.5v/div	150ns	6 cm	$225.00
76-06	4 Trace 1,2,3,4, 1&4, 2&3, 123&4, 1±2 & 3±4, 3±4	DC-20mc	17.5ns	20mv-10v/div	(230ns) option	6 cm	$620.00 $695.00 with signal delay
76-07	Differential Comparator A,-B,A-B, A-Vc, Vc-B	DC-15mc	24ns	5mv-2v/div	(230ns) option	6 cm	$695.00 $770.00 with signal delay
76-08	Dual Trace A,B,Chop,Alt, A±B,2preamps cascaded	DC-50mc	7.5ns	50mv-20v/div	230ns	6 cm	$650.00
74-12	Differential Amplifier A,-B,A-B	DC-850kc	0.41μs	1mv-10v/div (500μv/div Y sensitivity)	no delay	6 vert 10 horiz	$169.50
74-15	Single Trace	DC-1mc	0.35μs	20mv-20v/div (10mv Y sens)	no delay	6 vert 10 horiz	$105.00
74-19	Single Trace	DC-5mc	.07μs	50mv/div	no delay	6 cm	$175.00

Type	Description	Sweep Rate	Magnifier	Sweep Delay Range	Trigger Sensitivity @ 100kc		Horizontal Amplifier		Price
					Internal	External	Bandwidth	Sensitivity	
74-03A	Time Base Generator (5ns/div)	50ns-2sec/div	X10	none	2mm	250mv	DC-4mc	100mv-10v/div	$345.00
74-11A	Dual Time Base Delaying Sweep	100ns-2sec/div	X10	.5μs-20sec	3mm	500mv	DC-2mc	200mv-20v/div	$675.00
74-13A	Dual Time Base Calibrated Delaying Sweep	100ns-2sec/div	X10	.25μs-20sec	3mm	500mv	DC-2mc	200mv-20v/div	$750.00
74-14	Time Base Generator (100ns/div)	1μs-2sec/div	X10	none	5mm @ 350kc	500mv @ 350kc	DC-350kc	100mv-10v/div	$175.00

TYPE 79-02A 100MC DUAL TRACE AMPLIFIER PLUG-IN



doubles the performance of all other solid state units ■ gives widest bandwidth dual trace available ■ 3.5ns risetime ■ 10mv/cm sensitivity (X10 amplifier) ■ 1 mc or 100 kc chop rate ■ solid state circuitry ■ beam finder ■ dual trace (10mv/cm) 100mc amplifier ■ with inputs cascaded, single trace 1mv/cm at 50mc

Sensitivity—X1 Amplifier—100mv/div to 20volts/div in 8 calibrated steps of 1,2,5 sequence, variable gain control gives 2½ to 1 continuous sensitivity adjustment

X10 Amplifier—10mv/div to 2volts/div in 8 calibrated steps of 1,2,5 sequence; variable gain control provides continuous sensitivity adjustment from 2volts/div to 5volts/division

Risetime—3.5ns

Bandwidth—DC to 100mc, down 3db when DC coupled

Modes of Operation—
Ch. 1 only, Ch. 2 only, Chop (sampled at 1mc or 100kc rate), Alternate (switched on alternate sweeps), Algebraically added

Chop Rate Selection—Select rates of 1mc or 100kc with the internal selector switch.

Input Coupling—Either AC or DC coupling of the input signal is provided each channel by lever switch; off position on the input coupling switch provides ground reference or base line.

Input Impedance—1 megohm paralleled by 14pf. With Type 7990 X10 Attenuator Probe, 10 megohms paralleled by 7pf.

Signal Delay—230ns delay is built in. Delay is sufficient for view of base line and the leading edge of a fast risetime pulse.

Internal Trigger Mode—The two-position switch provides selection of trigger from composite signal or Channel 2 only.

Cascaded Amplifiers—Two preamplifiers cascaded give a high gain single trace unit 1mv/div; 50mc bandpass with front panel switch.

Channel 2 Output—Front panel jack access, 5k output imp.

Modification for Standard Main Frame Indicators—Modification Kit, with new CRT and termination, gives vertical standardization of 765H and 757 Series Main Frames, for optimum results with the 79-02A (and all 76-00 series) plug-ins. Main Frame Modification Kit **$235.00.**

Type 79-02A 100mc Dual Trace Amplifier **$1200.00**

ACCESSORIES

TYPE	DESCRIPTION	PRICE
4285A	Termination, 50 ohm, BNC Connectors	$16.50
7093	5:1 Attenuator Pad, 50 ohms BNC to BNC	16.50
4287	UG-306A/U BNC 90° Elbow	3.50
7081	BNC T-Connector (UG-274/U)	3.50
7082	BNC to BNC Jumper Cable (42")	4.75
7990	Attenuator Probe X10 (3½' cable) with high frequency compensation	45.00

TYPE 74-20A TIME BASE & RASTER DISPLAY PLUG-IN

resolves time display to 1 part in 5000 ■ single shot or repetitive displays ■ 1μs time per raster line ■ raster sweep linearity 1% ■ raster display or conventional sweep time base ■ use with dual trace signal amplifier plug-ins ■ response to 100mc ■ local or remote rearm

Raster Display—Time/line 1μs to 20sec in 23 1,2,5 steps; 3% accurate; 120ns starting time; Time/frame 0.6μs to 1.2sec in 23 1,2,5 steps; 2½:1 continuous change variable control; 12sec slowest; 1% sweep linearity in X1, 3% in X10; 1 to 100+ lines/frame; turnaround nominally 65ns; rearm for single frame with push button or front panel connector

Conventional Sweep—100ns/div to 2sec/div; 23 steps 1,2,5; 1% nominal accuracy; 2½:1 variable sweep; X10 magnifier expands sweep rate to 10ns/cm.

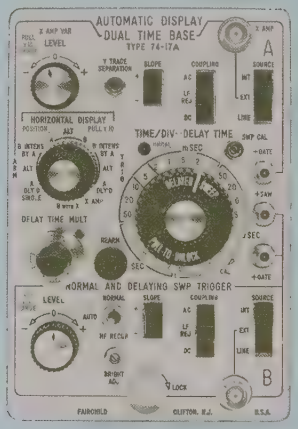
Output Signals—8volts into 10k gateout; 8volts into 10k sawout for time/frame.

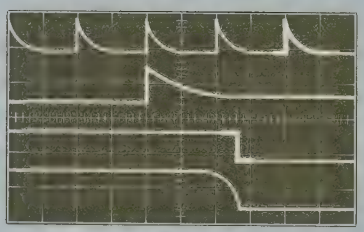
Triggering—selects signals from internal, external, or line sources, + or — slopes, DC or AC coupled; low freq reject position for sync signals over 10kc or risetimes faster than 100μs

Type 74-20A Time Base & Raster Display (with 7082 connecting cable) **$985.00**

FAIRCHILD

New Plug-ins 765 Series





	74-91	74-92	74-93
Center Frequency Range	10cps to 20kc	35cps to 100kc	150cps to 500kc
Calibrated Tuning Dial Range	0 to 20kc	0 to 100kc	0 to 500kc
Dispersion (sweep width) Continuously Variable	100cps to 6kc	500cps to 30kc	2.5kc to 150kc
Resolution Bandwidth (continuously variable)	10cps to 100cps	35cps to 250cps	150cps to 2kc
IF Frequency	100kc	262kc	1.5mc
Oscillator Frequency	120kc to 100kc	362kc to 262kc	2mc to 1.5mc
Price	$820	$820	$820

TYPE 74-17A AUTOMATIC BEAM SWITCHING & DELAYING SWEEP PLUG-IN

2 independent sweeps (beam switching) ■ full bandpass triggering ■ solid state circuitry ■ internal precision delay ■ 5ns/cm sweep rate ■ delaying sweep generator or two independent sweeps ■ alternate presentations of A signal at 2 different speeds ■ dual trace ■ automatic beam switching between normal sweep & X-Y displays

Sweep Range—Both sweeps have calibrated range from 50ns/div to 2sec/div in 24 steps of 1,2,5 sequence; nominal accuracy 1%; variable control continuous 2½:1

X10 Magnifier—increases sweep rate of both delaying & delayed sweeps to 5ns/div

Normal, A or B Sweep—Conventional time base display

Automatic Dual Scope Display—Both A & B shown; electronic switch alternates sweeps A & B

Triggered or Armed Mode—Sweep B intensified by A, Sweep B display shows A as brightened sector, A starts immediately after delay pickoff trigger generated; Sweep A delayed; Alternate Display, Sweep B intensified by A, and A delayed by B

X Amplifier—For X-Y displays

Alternate, X-Amp & Sweep B—X-Amp & B displayed alternately

Time Delay—Sweep A can be continuously delayed from 1/4μs to 20sec with nominal accuracy ±1%, delay time incremental linearity within ±0.25%

Trigger Capabilities—Both sweep generators have identical independent trigger circuits, auto & high frequency sync in B sweep trigger circuit

Trigger Selection—select signals from internal, external or line sources, plus or minus slopes, DC or AC coupled; low frequency reject position for sync signals over 10kc or rise-time faster than 100μs

Trigger Level—±15volts, X10 range extends external trigger level to ±150volts

Auto Sync—Special circuit provides bright base line display in the absence of trigger signal

Horizontal Amplifier—Nominal sensitivity 0.02volts/div (X10 expand), bandwidth 2.5mc, amplifier available through Sweep A external trigger input connector when in X amplifier mode, position indicator lights show beam direction when off screen

Type 74-17A Beam Switching & Delaying Sweep **$1225.00**

74-90 SERIES

SPECTRUM ANALYZER PLUG-INS

74-91 (DC TO 20 KC), 74-92 (DC TO 100 KC), 74-93 (DC TO 500 KC)

manual sweep ■ exceptional accuracy ■ fit all Fairchild solid state scopes ■ incidental FM less than 1% ■ vertical & horizontal output for X-Y recorder ■ use for telemetry subcarrier oscillator analysis ■ measure vibration, noise & distortion ■ harmonic & intermodulation distortion ■ sonar & subcarrier analysis ■ spectral & energy distribution ■ power level measurements ■ manual sweep for frequency determination to accuracy limited only by external counter

Modes of Operation—Normal, tuning dial determines center frequency; Full Scan, entire band displayed; Manual, DC voltage to sweep oscillator & position beam

Tuning Dial & Dispersion Accuracy—±10%

Display—input voltage amplitude scales linear or 40db logarithmic

Sensitivity—45μvolts/cm maximum sensitivity

Noise Level—less than 10μvolts referred to input

Amplitude Scale Accuracy—linear ±10%, ±1db

Amplitude Response Flatness—±1db

Sweep Rate—determined by time/cm switch setting

Input Attenuator—80db max, 20db steps

Input Impedance—1 megohm shunted by 50pf

Dynamic Range—harmonic and IM products 60db down

Incidental FM—less than 1% narrowest resolution bandwidth

IF Attenuator—40db max, 20db steps

IF Gain Control—20db continuously variable

Oscillator Output—1volt p-p min from 4.7k ohms

Video Filter (low pass)—50ms, selectable front panel switch

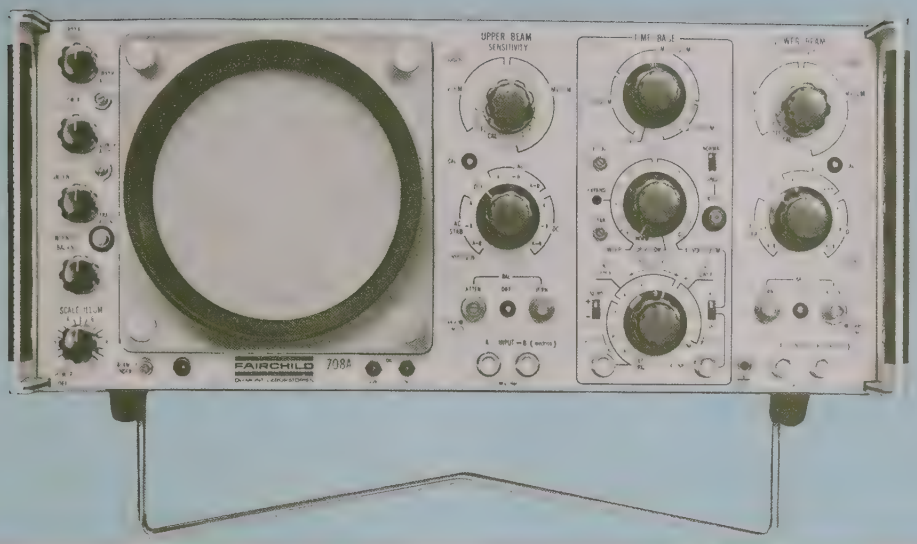
Vertical Output—minus .5v/cm from 47k, DC coupled

Horizontal Output—1volt peak neg from 10k ohms coupled

New

708A

FAIRCHILD



TYPE 708A HIGH GAIN DUAL BEAM OSCILLOSCOPE

no time sharing ■ dual gun CRT ■ two identical vertical amplifiers ■ 10μv/cm sensitivity ■ selectable bandpass ■ stabilized amplifiers ■ 6 x 10 cm viewing area each beam ■ 5kv aluminized high intensity CRT ■ universal bench & 7" rack mount ■ simple panel controls ■ unique electrometer type input stage ■ exceptional stability ■ wide range sweep (0.1μs/cm to 1 minute full scale) ■ transistorized amplifiers ■ indicator for transducers ■ electromedical research ■ servo work ■ general purpose ■ dual beam display without time sharing

UPPER & LOWER BEAM VERTICAL AMPLIFIERS

Sensitivity—10μv to 10volts/cm in 19 steps of 1,2,5 sequence ■ pull variable control for 2½:1 continuous variation 10μv/cm to 25volts/cm; amplifier attenuators compensated for probes; differential input operation on all ranges

Bandwidth—DC to 500kc (down 3db) selectable in 3 switch steps, DC to 5kc, DC to 50kc, DC to 500kc; AC coupled, low frequency 3db point is 5cps

Modes of Operation—front panel switch selects modes for each beam, Input A only, Input —B only, Differential input

Attenuator Accuracy—within 3%

Common Mode Rejection—100:1 (40db) from 0.2mv/cm, common mode signal not to exceed 6volts p-p or ±3 volts DC; at least 20db all other ranges

Differential Input—All attenuator ranges of upper & lower beam amplifiers

Phase Shift—between orthogonal (X-Y) system adjustable to within ±1° at any point from DC to 100kc at calibrated gain; adjusted to 0° phase shift at 100kc, differential is ±2° from DC to 150kc

Input Coupling—DC or AC; AC coupled, low frequency 3db point 5cps; input signals of 600volts p-p AC or DC; AC stabilized for low input signals

Input Impedance—Single Ended, 1 megohm paralleled by 50pf; Differential, 2 megohms paralleled by less than 40pf

X-Y Plotting—Front panel switch provides lower vertical amplifier plotted against upper vertical amplifier.

TIME BASE

Sweep Range—Calibrated from 5μs to 2sec/cm in 18 steps of 1,2,5 sequence; accuracy always better than 3%; variable control extends slowest sweep to 6sec/cm (1 minute full scale); expander extends fastest rate to 100ns/cm

Expander—6 step expander for sweep expansion of X1, X2, X5, X10, X20, X50; with X50 magnifier sweep rate 100ns/cm; expansion accuracy 5% for sweep rates to 1μs/cm, 10% for faster sweep rates

Triggering Capabilities—trigger from internal either beam, external & line sources on either positive or negative slopes

Trigger Sensitivity—Internal, signals synchronized from 4mm vertical deflection driven sweep; when in auto sync less than 3mm required for trigger DC to 500kc; internal trigger DC coupling gives triggered reference to CRT scale

External, trigger from DC to 500kc at signal level of 500mv p-p; 400mv p-p required in auto trigger

Auto Trigger—sweep will free run at 50cps rate in absence of sync signal

Trigger Level—±10volts on external, ±1.5volts full scale on internal

Single Sweep—push button rearming switch and rearm indicator light on front panel; remote electrical rearming available thru BNC on rear

HORIZONTAL AMPLIFIER

Sensitivity—20mv to 1volt/cm in 6 steps of 1,2,5 sequence; pull variable control (uncalibrated) permits 3:1 adjustment for continuous variation between 20mv/cm and 3volts/cm

Bandwidth—DC to 1mc, down 3db; AC coupled, low frequency 3db point 5cps

Risetime—.35μs

Calibration Accuracy—built-in 5cm calibration signal for easy calibration; accuracy within 3% any one setting on volts/cm switch

Input Impedance—1 megohm paralleled by 50pf; with X10 probe (Type 4290) 10 megohms paralleled by 13pf

DISPLAY

Cathode-Ray Tube—flat faced 5inch dual gun tight tolerance CRT; aluminized post-accelerator tube has 5kv accelerating potential, high brightness, good contrast and beam gating, automatic screen burn protection; P31 phosphor usually supplied; P7, P11 phosphors available; two completely independent electron guns have independent vertical deflection plates and common horizontal deflection plates

Accelerating Potential—5kv

CRT Scale—6 x 10cm each gun; illuminated graticule, 5cm overlap

Beam Finder—push-button beam finder

Z-Axis—negative pulse of 25volts required to blank trace; AC coupled to grid of CRT, 1 megohm through series 0.01μf capacitor; available through BNC at rear

GENERAL

Calibrator—line frequency, internal 5cm cal, external .2v and 2v for probe compensation

Power Requirements—115 or 230volt line, 200watts, 48-450cps

Temperature Range—Storage, —40°C to 85°C; Operating, 0°C to 50°C (no vent fan required)

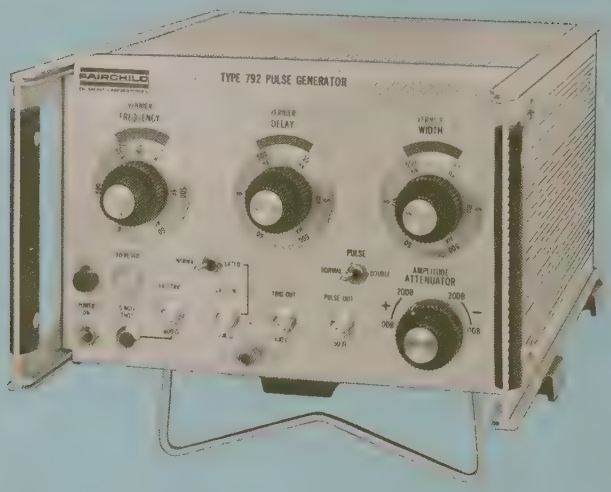
Vibration & Shock—National Safe Transit Test

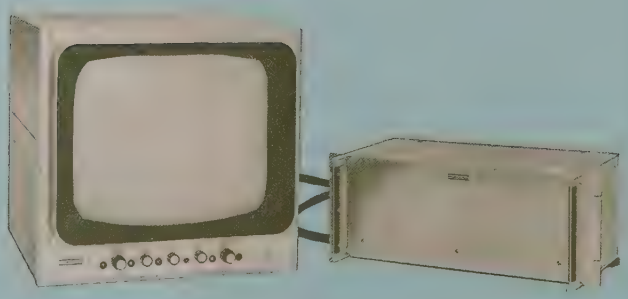
Bench (tilt stand supplied) 7⅝" (19.3cm) H x 16¾" (42.5cm) W x 21" (53.3cm) D; Rack (use optional Type 7086 mounting ears) 6-31/32" (17.7cm) H x 16¾" (42.5cm) W x 17½" (44.5cm) D; 35# net, 40# shipping

Type 708A Dual Beam Scope **$945.00**

FAIRCHILD

New Type 792 Type 737





TYPE 792 DOUBLE OR SINGLE PULSE GENERATOR

10mc pulse repetition rate ■ gated operation ■ constant amplitude ■ ±10volts into 50ohms ■ light weight ■ rugged ■ solid state

Amplitude—10volts into 50ohms, 17volts into 1000ohms

Risetime—10ns or less

Fall Time—10ns or less

Polarity—positive or negative

Pulse Droop—Negligible all ranges

Undershoot & Overshoot—5% or less at maximum amplitude

Repetition Rate—50cps to 5mc, double pulse to 10mc

External Trigger In—AC coupled, 3volts minimum (positive, Z_{in}=600ohms); Any rate up to 5mc

Single Pulse—Single shot available with front panel push button switch; double or single pulse for every trigger pulse (change pulse switch to double pulse)

Pulse Delay—Continuously variable from 30ns before to 5ms after trigger output pulse

Width—50ns to 5ms

Duty Factor—30% can be increased to 70% at reduced amplitude

Trigger Out—4volts minimum (positive, 50ns wide into 1k ohms); 2volts minimum (50ns wide into 100ohms)

Gated Operation—AC coupled, Z_{in} =10k ohms, 10volts minimum; Positive response time = 80ns at minimum delay, 15volts minimum at 50% duty cycle on Gate; maximum gate width 10ms at 10% duty cycle and 15volts

Power—115/230v, 50-450cps

Mounting—Universal half rack configuration

Type 792 Double or Single Pulse Generator **$520.00**
(includes power cord, 4285A termination,
2 each 7082 cables)

TYPE 737 LARGE SCREEN ELECTROSTATIC X-Y INDICATOR

1mc large screen indicator ■ 17" electrostatic rectangular CRT ■ 88 square inch quality rectangle ■ full bandwidth X, Y & Z axes ■ DC coupling all axes ■ 10kv overall accelerating potential ■ high linearity ■ uniform spot size ■ bench or rack mount

Bandwidth (X & Y)—DC Coupled, DC to 1mc down 3db measured at full screen

Risetime, 0.35μsec maximum measured 10% to 90% with less than 2% overshoot

Sensitivity (X & Y)—1 volt full screen, continuously variable to 5v full screen

Input Impedance—1 megohm shunted by 40pf ±10%; BNC connectors at rear of indicator

Common Mode—±25volts offset potential, 30db minimum common mode rejection DC to 1kc, 20db to 10kc

Deflection Linearity—±2% maximum overall within quality rectangle; ±10% maximum, 1-division increments

Phase Shift—Phase shift between orthogonal systems ±0.1 degree maximum at 1kc and ±1degree maximum at 100kc; internal adjustment provided

Stability—Less than ½cm drift per hour at maximum sensitivity (controlled ambient and line voltage conditions)

Positioning Range—Minimum of full screen

Z Axis—DC coupled, 5v signal will blank or intensify normal trace

Cathode-Ray Tube—With P31 phosphor normally supplied; P7, optional phosphor; 8 x 10 or 10 x 10 div internal graticules optional at additional cost

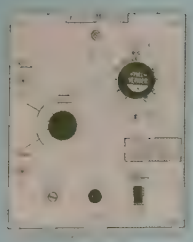
Accelerating Voltage—10kv

Display Area—Quality rectangle 21cm x 28cm minimum, overall scan 25 x 31cm

AC Power—115/230v, 50/60cps, 750w (50-400 operation optional)

Mechanical Dimensions—universal bench or rack use (rack mount adapter plates included); Indicator Unit 15¾" maximum H x 16¾" max W x 18¾" max D (17" behind rack mounting surface, CRT housing extends 5¾" behind rear panel) approx 65#; Power Supply 7" max H x 16¾" max W x 11" max D (includes connectors) interconnecting cable 5' approx 48#

Type 737 Large Screen X-Y Indicator **$3450.00**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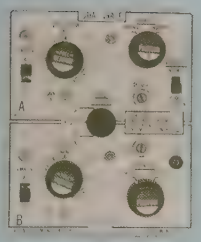
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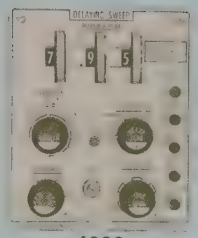
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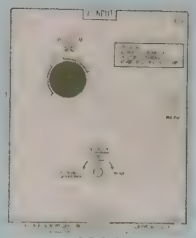
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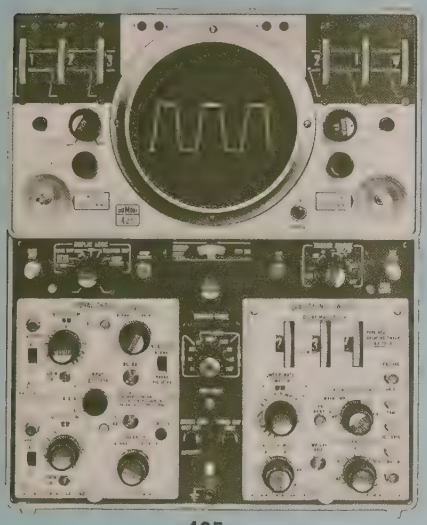
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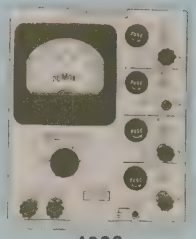
4207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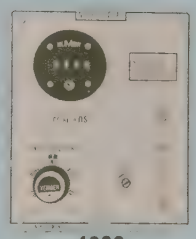
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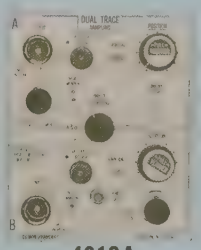
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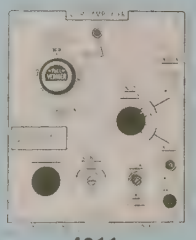
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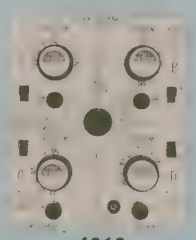

4212

TYPE 425 DIGITAL READOUT GENERAL PURPOSE SCOPE

measurement accuracy ■ modular construction ■ wide selection X & Y plug-ins ■ any lab or production application ■ 2 dots superimposed on waveforms ■ joystick controls ■ use as a-d converter ■ attach punch card or any print-out device ■ direct digital readout 2 axes

Frequency Range—DC-35mc; 1 kmc with sampling plug-ins
Risetime—Y-10ns; X-90ns; to .35ns with sampling plug-ins
Sweep Rate—Fastest 10ns/cm (to .1ns/cm with sampling plug-ins); slowest 6 sec/cm
Display—5 x 10 cm 12kv CRT

13½" (34.3cm) W x 27" (68.5cm) D x 16½" (41.9cm) H, 125# — Main Frame **$2,975.00**

TYPE 4201
Description— Y-Preamplifier Single Channel
Sensitivity— 50mv/cm to 20v/cm
Bandpass— DC to 35 mc
Price— **$195.00**

TYPE 4202
Description— Dual Trace Y Preamplifier
Sensitivity— 50mv/cm
Bandpass— DC to 33 mc both traces
Price— **$295.00**

TYPE 4203
Description— Delaying Sweep
Sensitivity— 25ns to 10sec
Time Base— continuous variable, .5% precision, less than 1/20,000 jitter
Price— **$495.00**

TYPE 4204
Description— X Input
Sensitivity— 2v/cm to 10v/cm
Bandpass— DC to 4 mc
Price— **$125.00**

TYPE 4205
Description— Y Preamplifier
Sensitivity— 5mv/cm to 2v/cm
Bandpass— DC to 21 mc
Price— **$275.00**

TYPE 4207
Description— Y Test Unit provides test signals; vertical amplifier alignment and recalibration
Price— **$140.00**

TYPE 4208
Description— Power Access for Systems use in lab 5 regulated outputs +420v to −150v
Price— **$75.00**

TYPE 4209
Description— Micro Delay for precise incremental t_r and delay measurement
Delay— 0-100ns, .1ns resolution trigger delay
Price— **$295.00**

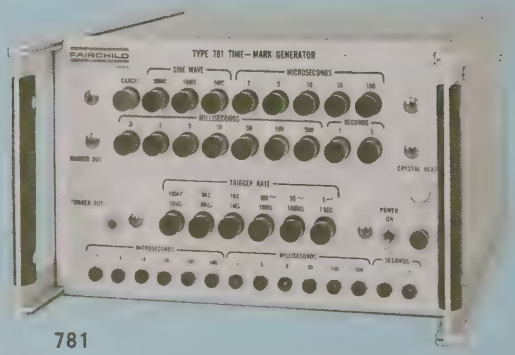
TYPE 4210 A/B
Description— Sampling plug-in
Sensitivity— 5mv/cm
Bandpass & Time Base— DC-1000mc bw, .35ns t_r, 50 ohm input, .2ns/cm to 10ns/cm sweep speeds 1,2, 5 steps, 0-100ns delay
Price— **$1495.00**

TYPE 4211
Description— Sweep Expander and X Preamp for X-Y with stable wideband (2mc)
Time Base— Sweep expand to X100
Price— **$235.00**

TYPE 4212
Description— Four Trace for single, dual or 4-traces display of unrelated signals, algebraically added dual trace and dual trace with readout
Bandpass— DC to 30mc
Sensitivity— 50mv/cm to 2v/cm
Price— **$545.00**

FAIRCHILD

Types
781
791
404-B



781

791

404-B

TYPE 781 TIME MARK GENERATOR

14 time mark intervals 1μs-5sec ■ 5,10,50mc sine wave outputs ■ 6 decade trigger ■ .001% accuracy ■ 3/1,000,000/day stability ■ solid state circuitry ■ MIL type circuit boards ■ plated through holes ■ low heat and power consumption

Time Markers—1,5,10,50,100,500μs; 1,5,10,100,500 ms; 1 & 5 sec; 2 simultaneous outputs, individual markers with push button selectors and BNC output jack; 25v open circuit from tip jacks; 4v open circuit from marker output jack
Sine Wave—3 outputs 5,10,50mc; button switch selectable 3v p-p output across 50 ohms
Trigger Rate Generator—1,10,100 cps 1,10,100 kc coincident with time marker
Stability & Jitter—pulses from temp stable 1mc crystal, variation of 10cps/1mc, can be beat with WWV via trimmer cap, stable to 3/1,000,000/24hrs; pulse-pulse jitter under .05% of rep rate
Power—110/220v, 21w, 48 to 450cps

5¼" (13.3cm) H x 8¼" (21cm) W x 10½" (26.6cm) D with handle, 9.5# **$595.00**

TYPE 791 SQUARE WAVE GENERATOR

7 cycle to 10 mc square wave output ■ 3ns fall time ■ 6ns risetime ■ 40v open circuit ■ 20w ■ solid state circuitry ■ wide frequency range

Square Wave Output—25cy to 10mc, 12 steps 1,2,5 sequence; less than 3ns fall time when terminated in 50 ohms; less than 6ns risetime term 50 ohms; termination selector switch for 600 or 50 ohms; output amplitude continuously variable

Source Impedance Output Voltage Range		
	Source Impedance	
Load	600 Ohm	50 Ohm
Open Circuit	3-40volts	.25-3volts
600 Ohm Output Impedance	1.5-20volts	.23-3volts
50 Ohm Output Impedance	.25-3volts	.125-1.5volts

Trigger Output—max risetime 10ns terminated @ 50 ohms; select pos or neg polarity of square wave; 5v into 50 ohms
External Sync—Square wave freq slave to ext freq max sync 1mc
Other—110/220v, 20w, 48-450 cps

5¼" (13.3cm) H x 8¼" (21cm) W x 10½" (26.6cm) D with handle, 9.5# **$420.00**

TYPE 404-B PULSE GENERATOR

50 V into 50 Ohms ■ 13ns risetime ■ variable internal delay ■ variable pulse width ■ rep rates to 250,000 pps ■ single push button actuated pulse of selected width and amplitude

Pulse—peak voltage 50v ±10% 50 ohm term, 75v ±20% 75 ohm term, 95v ±20% 95 ohm term; 13ns rise or fall time; 5% max tilt pos pulse, 15% max neg pulse; 59.5db in .5db incr atten; ±1% accurate; 50 ohms output imp direct or thru atten; 5w max pulse power; 50w max peak pulse; 1 amp max peak pulse current; .05-105μsec pulse width in 3 cal ranges; min pulse width adj to 25ns; 9-12% auto duty limit protect indicator
Trigger—rep rate under 10pps to over 250,000pps cont var int, single pulse to 250kc ext; min amplitude 4v peak, max 60v; pos or neg ext polarity; 10v amplitude term 91 ohms; advance to 2μsec or delay to 12.5ms
Power—110/220v, 60 cycle line

Bench 11⅜" (20.89cm) H x 17⅝" (44.7cm) W x 16½" (41.91 cm) D with knobs, 55#, Type 404-B **$760.00**

Rack 10¼" (26.67cm) H x 16⅞" (42.85cm) W x 15²⁄₃₂" (38.65cm) D, 55#, Type 404-BR **$760.00**

ACCESSORIES

TYPE NO.	DESCRIPTION	PRICE
4285-A	50 Ohm Termination	$ 16.50
7093	5 to 1 Attenuator	16.50
7012	Capacitance Standardizer — nominal tuning range of 20 to 55 pf	12.50
7085	Detented Tilt-Slide for the 700 and 765H series	40.00
4006	Detented Tilt-Slide for the 403BR and 440R	40.00
7099	Rack Slides for 781 and 791	40.00
7086	Rack Mount Ears for the 700 series and 767H series	5.00
4273	Cradle Type Rack Mount for the 425	75.00
7087	Luggage Type Carry Handle for 700 to 704 and 767H scopes	2.00
7090	Protective Cover for front of 700 to 704 and 767H	35.00
7095	Protective Cover, 5" high panel	30.00
7091	Fitted Accessory Mounting Board for type 7090 protective cover	10.00
7097	Hardware Kit for common packaging of 781 with 791	15.00
7096	Rack Mount Ears for common 781-791 package	5.00
7098	Blank ½ Rack Panel for full rack mounting of 781 or 791	25.00
7094	Protective Panel Cover for the 781 or 791	25.00
7092	Storage Cabinet for all 765 series plug-ins	38.50
2592-B	Terminal Adaptor, binding post to female BNC	10.00
4283	Terminal Adaptor, "GR" to BNC male	7.50
4286	Terminal Adaptor, UHF female to male BNC	3.50
4287	UG #306A/U 90° BNC elbow	3.50
7080	Terminal Adaptor, BNC to binding post UG #1090/U	2.35
7081	UG #274/U BNC "T" Connector	3.50
7084	Terminal Adaptor, male "C" to female BNC, UG #636/U	3.50
7082	Cable, male BNC to male BNC, 42" length of 50 ohm coax	4.75
7083	Cable, male BNC to insulated alligator spring clips, 42" long	3.85
7030	Scope Traveler (size of top tray 17¾" x 22½")	75.00
7031	Scope Traveler Drawer (top tray 17¾" wide)	34.50
7020	Scope Traveler (size of top tray 10¾" x 22½")	65.00
7021	Scope Traveler Accessory Drawer only	30.00
7022	Scope Traveler Accessory Drawer and Plug-In Carrier, UL approved AC Outlet	34.50
4270	Scope Traveler (tray size 16" x 27") capacity 500 pounds	85.00
7010	2000 Hours Maintenance Kit	250.00
7011	2500 Hours Maintenance Kit with 5 kv CRT	395.00
7011-H	2500 Hours Maintenance Kit with 13 kv CRT	450.00
4294	Plug-in Extension Cable (25" long extension cable for plug-ins in the 425 and 765H series scopes)	35.00
7013	Tool Kit for 765H series maintenance	9.50
4295	Tool Kit for 425 oscilloscope recalibration	65.00
4296-A	Operational Accessory Kit for 425 and 765 series	95.00
4002-B	General Accessory Kit — low frequency	95.00
7035	Viewing Hood — round light shield	4.95
276-C	Viewing Hood, molded rubber	14.00
4005	Tilt Stand and Line Cord Reel Kit for 403B, 436 and 440 oscilloscopes (factory installed $10.00 additional)	4.75
7651-A	Self-Storing Plastic Insert, complete with accessories for 765 Porta-Scope	185.00
74-00	Blank Plug-In Chassis for 765H series	35.00
7001	Delay Line (230 nanoseconds) for 765H series plug-ins	75.00
7002	Delay Line for 76-06 plug-in	75.00
4561	Bezel for Tektronix rectangular type CRT oscilloscopes	14.50
4551	Bezel for Tektronix round type CRT oscilloscopes	4.50
7079	Rear Access Connectors for 767H and 757 rack mounted oscilloscopes	30.00
7089	Rear Access Connectors for 700, 701, 702, 704 oscilloscopes	12.50
7088	Z Axis Modulation for 700, 701, 702 or 704 scopes (factory installation $3.00 additional)	8.75
4279	DC Fan Motor Mod Kit (400 CPS operation) for 425 oscilloscope Factory installed before shipment	100.00 75.00

GENERAL PURPOSE PROBES

Probe Type	Resistance	Input Capacitance	Attenuation Ratio	Cable Length	Price
4289	1 meg	59-91 pf	1:1	4 ft	$30.00
4290	10	10-13	10:1	4	30.00
4290-A	10	10-13	10:1	4	30.00
4298	10	14-17	10:1	8	32.50
4298-A	10	14-17	10:1	8	32.50
4299	10	12-15	10:1	6	32.50
4299-A	10	12-15	10:1	6	32.50
4292	10	1.7-2.5	100:1	4	32.50

PLEXIGLASS FILTERS FOR 700, 701, 702, 704, 765H SERIES

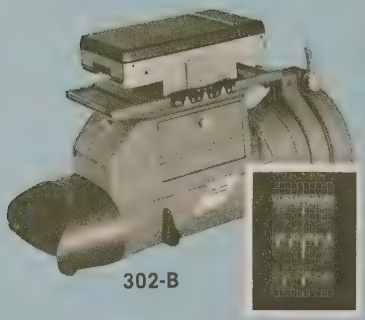
Type	Part Number	Phosphor Type	Price
Blue	4800 4512 4800 5862	P11 P7	$1.25 1.25
Green	4800 4511 4800 5863	P1 P2 - P31	1.25 1.25
Amber	4800 5861	P7	1.25
Polaroid Plexiglass scale	4800 6101		2.50

INTERNAL GRATICULE CRT'S

For Scope Type	Type No.	Factory Installed	Field Kit
700, 701, 702, 704	7042	$15.00 additional	$ 75.00
765 Series, 5 kv	7060	35.00	110.00
765H Series, 13 kv	7061	35.00	175.00

FAIRCHILD

Types
302-B
321-A
450-A
453 /
453-A



302-B

TYPE 302-B

POLAROID CAMERA FOR 5" SCOPE

record on Polaroid Film Pack 3¼" x 4¼" and 4" x 5" with Graflok back ■ or conventional 2¼" x 3¼" roll film ■ mount on any 5" scope ■ simultaneous recording of data and viewing of trace ■ direct no-parallax viewing of screen ■ slide back along focal plane ■ expose more than one trace per frame ■ detent mechanism positions back for 9 equally spaced exposures ■ observe data card and trace through dichroic mirror while recording

Model No.	Lens-Shutter Assembly Description	Price
302-B	f/1.9 lens—Wollensak-DuMont 75mm, 1:0.45 Fixed Object-to-Image Ratio	$435.00

Specifications

Lens	Optical System	Object-to-Image Ratio	Aperture Settings	Shutter Speeds
f/1.9 75mm	Wollensak-DuMont, No. 3 Alphax heavy duty shutter	1:0.45 fixed	f/1.9, f/2.8, f/4, f/5.6, f/8, f/11, f/16	1/100 to 1 sec., time and bulb

RECORDING MATERIALS: Polaroid 107 eight-exposure 3¼" x 4¼" film pack for type 4520-B; Polaroid types 55 P/N, 52, and 57—410 Polascope 3¼" x 4¼" 4" x 5" film packet; Polaroid types 42, 44, 46L, 47, and roll films (for cameras which still use Polaroid film adapter type 4520-A; 4" x 5" regular sheet film; and 2¼" x 3¼" standard 120 roll film.

321-A

TYPE 321-A

35mm CONTINUOUS MOTION RECORDING CAMERA

18 controlled film speeds ■ friction film drive ■ built-in timing lamp ■ continuous motion and manual single frame recording ■ from any 5" oscilloscope ■ friction transport drive coupled to 1800 rpm sync motor ■ 16 speeds from .8-3600"/minute for up to 400' ■ speeds of 5400 and 10,800"/minute for lengths to 100' ■ use perforated or unperforated film ■ use economy recording paper ■ stop film in 6" @ highest speed ■ shuttered binocular port for viewing screen while recording ■ for short term long interval time use

Model No.	Lens-Shutter Assembly Description	Price
321-A-1 (60 cps)	f/1.5 lens — Oscillo-Raptar 51mm, 1:0.22 Object-to-Image Ratio	$1525.00
321-A-2 (50 cps)	f/1.5 lens — Oscillo-Raptar 51mm, 1:0.22 Object-to-Image Ratio	1600.00

Specifications

Type No.	Lens	Optical System	Object-to-Image Ratio	Shutter	Film Speeds
321-A-1 & 2 (includes lens, tripod, housing, 2 mags.)	f/1.5 51mm	Wollensak Oscillo-Raptar (flat field) lens, factory-focused to image a plane ¾ inch beyond viewing housing.	1:0.22 fixed	Capping type; actuated by drive solenoid	Variable in steps of: 0.8, 1.6, 2.5, 4.9, 7.4, 14.8, 22.2, 44.4, 66.6, 133.3, 200, 400, 600, 1200, 1800 and 3600 in/min. Also — 5400 and 10,800 in/min. with film strips up to 100 feet in length

RECORDING MATERIALS: Perforated or unperforated 35mm film or recording paper—in lengths up to 400 feet on cores and 100 feet daylight loading spools.

450-A

SERIES 450-A

POLAROID® 3¼" x 4¼" film pack holder with dark slide-type 4520-B (includes 4563 focusing plate)

Model No.	Lens-Shutter Assembly Description	Lens Type	Film Holder No.	Housing No.	Price
450-A-1	f/1.9 lens—Oscillo-Raptar 75mm, 1:1 thru 1:0.85 Object-to-Image Ratio	4511	4520-B	4500-A	$495.00
450-A-2	f/1.9 lens—Oscillo-Raptar 63mm, 1:0.5 thru 1:0.45 Object-to-Image Ratio	4512	4520-B	4500-A	495.00
450-A-3	f/1.9 lens—Oscillo-Raptar 75mm, 1:1 thru 1:0.85 Object-to-Image Ratio	4511	4515	4500-A	500.00
450-A-4	f/1.9 lens—Oscillo-Raptar 63mm, 1:0.5 thru 1:0.45 Object-to-Image Ratio	4512	4515	4500-A	500.00

453

SERIES 453/ 453-A

POLAROID® 3¼" x 4¼" film pack holder with dark slide-type 4520-B (includes 4563 focusing plate)

Model No.	Lens-Shutter Assembly Description	Lens Type	Film Holder No.	Housing No.	Price
453-1	f/1.9 lens—Oscillo-Raptar 75mm, 1:1 thru 1:0.7 Object-to-Image Ratio	4533	4520-B	4503	$390.00
453-A-1	same as 453-1 but with swing-away and lift-off housing	4533	4520-B	4503-A	425.00
453-2	f/2.8 lens—Amaton 75mm, 1:1 thru 1:0.7 Object-to-Image Ratio	4553	4520-B	4503	350.00
453-A-2	same as 453-2, but with swing-away and lift-off housing	4553	4520-B	4503-A	385.00
453-3	f/1.9 lens—Oscillo-Raptar 75mm, 1:1 thru 1:0.7 Object-to-Image Ratio	4533	4515	4503	395.00
453-A-3	same as 453-3, but with swing-away and lift-off housing	4533	4515	4503-A	430.00
453-4	f/2.8 lens—Amaton 75mm, 1:1 thru 1:0.7 Object-to-Image Ratio	4553	4515	4503	355.00
453-A-4	same as 453-4, but with swing-away and lift-off housing	4553	4515	4503-A	390.00

CAMERA ACCESSORIES

Camera System Types				Description	Type	Price
450-A-1 thru 450-A-4	450-A-5	453-5, 453-A-5	453-1 and 453-A-1 thru 453-4 and 453-A-4			
	X	X		Film Cassette for type 4530-A (spare)	2636	$ 5.95
	X	X		Sweep Rearming Cable Assembly for 4530-A only	2637	4.95
X	X			Basic Camera Housing (with swing-away and lift-off mount)	4500-A	200.00
		X	X	Basic Camera Housing (non-swing-away)	4503	115.00
		X	X	Basic Camera Housing (with swing-away and lift-off mount)	4503-A	150.00
X				f/1.9 Lens, Oscillo-Raptar 75mm, 1:1 thru 1:0.85 object-to-image ratio (for recording with all 450-A series except 450-A-5, 35mm)	4511	200.00
X				f/1.9 Lens, Oscillo-Raptar 63mm, 1:0.5 thru 1:0.45 object-to-image ratio (for recording with all 450-A series except 450-A-5, 35mm)	4512	200.00
X				f/4.5 Lens, Oscillo-Raptar 114mm, 1:0.34 thru 1:0.095 object-to-image ratio for field diameters 7" to 20" (for recording with all 450-A series except 450-A-5, 35mm)	4513	225.00
X				Cable Assembly, remote single sweep rearm for synchro shutter types 4511, 4512 and 4513	4514	7.50
X			X	Graflok 4 x 5 Adapter with focusing & viewing hood	4515	100.00
X			X	Graphic 120 size 8 exp Film Adapter for type 4515	4516	31.50
X			X	Polaroid 4 x 5 Film Adapter	4517	49.95
X			X	Graphic 4 x 5 Sheet Film Holder, 2 exposures	4519	4.95
X			X	Polaroid 3¼ x 4¼ Film Pack Holder with dark slide, 8 exp	4520-B	95.00
X			X	Shutter Solenoid, battery powered, minimum RFI	4521	100.00
X			X	Shutter Solenoid, 24 volts DC	4522	100.00
X			X	Shutter Solenoid, 115 volts AC (50 to 400cps)	4523-A	125.00
X	X			Data Mirror Hinged Assembly for alternate recording of data and trace	4525	35.00
X	X			Data Card and Light Source Assembly (use with 4544 or 4525)	4526	30.00
X	X	X	X	Focusing & Imaging 7x Magnifier metric scale	4529	21.00
	X	X		Robot 35 mm Automatic Advance Recorder with f/1.5 — 51 mm lens	4530-A	450.00
	X	X		35 mm Film Magazine, 400 exposures, 30 ft.	4531-A	305.00
		X		Spring Booster Motor provides 50 frame advance	4532	129.00
			X	f/1.9 Lens, Oscillo-Raptar 75mm, 1:1 thru 1:0.7 object-to-image ratio	4533	180.00
	X	X		Shutter Solenoid, 110 volts AC	4534-A	37.95
	X	X		Shutter Solenoid, 24 volts DC	4535-A	39.95
	X	X		Electric Booster Motor, 24 volts DC for continuous advance	4536-A	199.00
	X	X		35 mm Film Magazine, 2400 exposures, 200 ft.	4538	349.00
	X	X		Shutter Solenoid, 24 volts DC, reverse action	4539-A	42.95
X			X	Polaroid 2 minute timer	4541	5.95
X	X	X	X	Storage & Carrying Case	4542	47.50
X	X			Dichroic Data Mirror for simultaneous recording of data and trace	4544	80.00
	X	X		Focusing Adapter (ground glass) for 4530-A camera only	4547	17.95
	X	X		Spare Take-up Spool for 4531-A	4548	6.95
	X	X		Spare Supply Spool for 4531-A	4549	6.95
X	X	X	X	Bezel to adapt camera to Tektronix 5" oscilloscopes equipped with round type CRT (Tektronix Model 545-A, etc)	4551	4.50
			X	f/2.8 Lens, Amaton 75mm, 1:1 thru 1:0.7 object-to-image ratio	4553	140.00
	X	X		Pushbutton activator switch and cable for solenoid types 4534-A, 4535-A and 4539-A	4555	9.50
	X	X		Automatic Film Advance Camera with reflex recording of 7 x 7mm data adjacent to 24 x 24mm image; includes 24-hr clock, 4-digit electric counter and 20mm x 55mm written data plate and 24-volt lighting	4560	860.00
X	X	X	X	Bezel to adapt camera to Tektronix 5" oscilloscopes equipped with rectangular type CRT (Tektronix Model 561-A, etc)	4561	14.50
X			X	Focusing Plate for 4520-B film pack holder (spare)	4563	2.50
	X	X		Automatic Recycler with two 24 vdc outputs for types 4530-A and 4560; also serves as 24 vdc accessory power supply; recycles with 7403-A time base plug-in and 4539-A solenoid	4564	245.00
				Techniques of Photo-Recording from Cathode-Ray Tubes Handbook (Library Edition)	67041861	4.50
				Type 107 Polaroid Film Pack, ASA 3200, 8 exposures each for 4520-B film pack holder, carton of six packs	48010360	14.00
				Type 47 Polaroid Film, ASA 3200 for 4520-B roll film adapter, carton of six 8-exposure rolls	48003150	14.00
				Type 410 Polaroid Film, ASA 10,000 for 4520-A roll film adapter, carton of six 8-exposure rolls	48003190	14.00

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All Fairchild Field Engineering Representatives are prepared to assist you in the service and maintenance of your Fairchild Instruments. Intensive training is provided at the factory and specialists will be sent to train your service personnel in your own plant. A complete warehouse of spare parts in Clifton, New Jersey, backs up your local Fairchild Field Engineer who stocks the most common spares. These service centers are authorized to provide maintenance support, from trained specialists.

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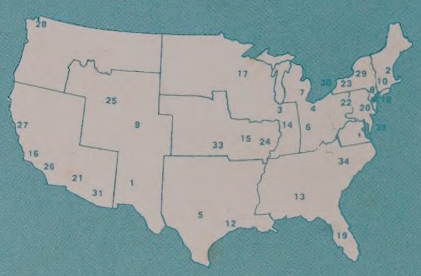

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